THE NEW EDDYSTONE LIGHTHOUSE.*

BY WILLIAM TREGARTHEN DOUGLASS, ASSOC. M. INST. C.E.

In a note submitted to the Institution by Sir James Douglass, M. Inst, C. E., during the session of 1877-78, the necessity was explained for the substitution of a new lighthouse for Smeaton's famous structure, which, having withstood the storms of more than a century with incalculable advantage to mankind, was stated to be "in a fair state of efficiency; but, unfortunately, the portion of the gneiss rock on which it is founded has been seriously shaken by the incessant heavy sea-strokes on the tower, and the rock is considerably undermined at its base. . . . Unfortunately, the waves rise, during stormy weather, considerably above the summit of the lantern, thus frequently eclipsing the light, and altering its distinctive character."[1] The latter defect was of little importance for many years after the erection of Smeaton's lighthouse, when individuality had not been given to coast lights and no signal lights were carried by shipping; but with the numerous coast and ship lights now visible every night on the seas surrounding this country, a reliably distinctive character for every coast light has become a matter of absolute necessity.

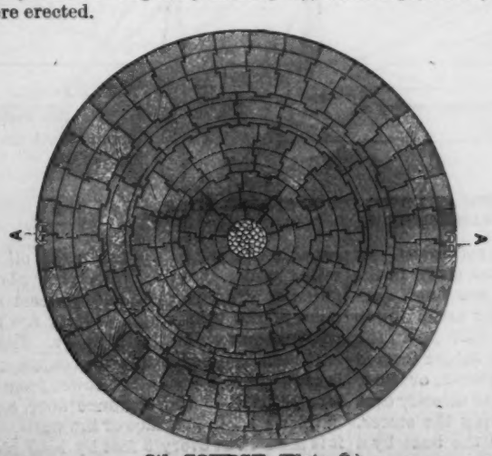
The Trinity House having, in 1877, determined on the erection of a new lighthouse, their Engineer-in-Chief was instructed to survey the site and submit a design for the proposed structure (Plate 2), together with an estimate of the cost, including the removal of the upper portion of Smeaton's lighthouse, namely that above the level of the top of the solid work, such removal being necessary for the security of the lower portion.

The site selected for the new tower is 120 feet south-southeast from Smeaton's lighthouse, from centre to centre. It will be observed from the section (Plate 1), that there is no probability of the rock at this point becoming undermined, the tower being founded in the actual body of the reef, with no surrounding point of attack at a lower level. The only drawback to the site was that a large portion of the foundation had to be laid below the level of low-water spring tides.

The estimate submitted for the work was £78,000. The design and estimate having been approved by the Trinity House, and the necessary statutory sanction procured for the outlay, tenders for executing the work were obtained from six contracting firms experienced in sea-works; but as the lowest tender was considerably in excess of the estimate of the Engineer-in-Chief, it was determined that the work should be executed by him without a contractor.

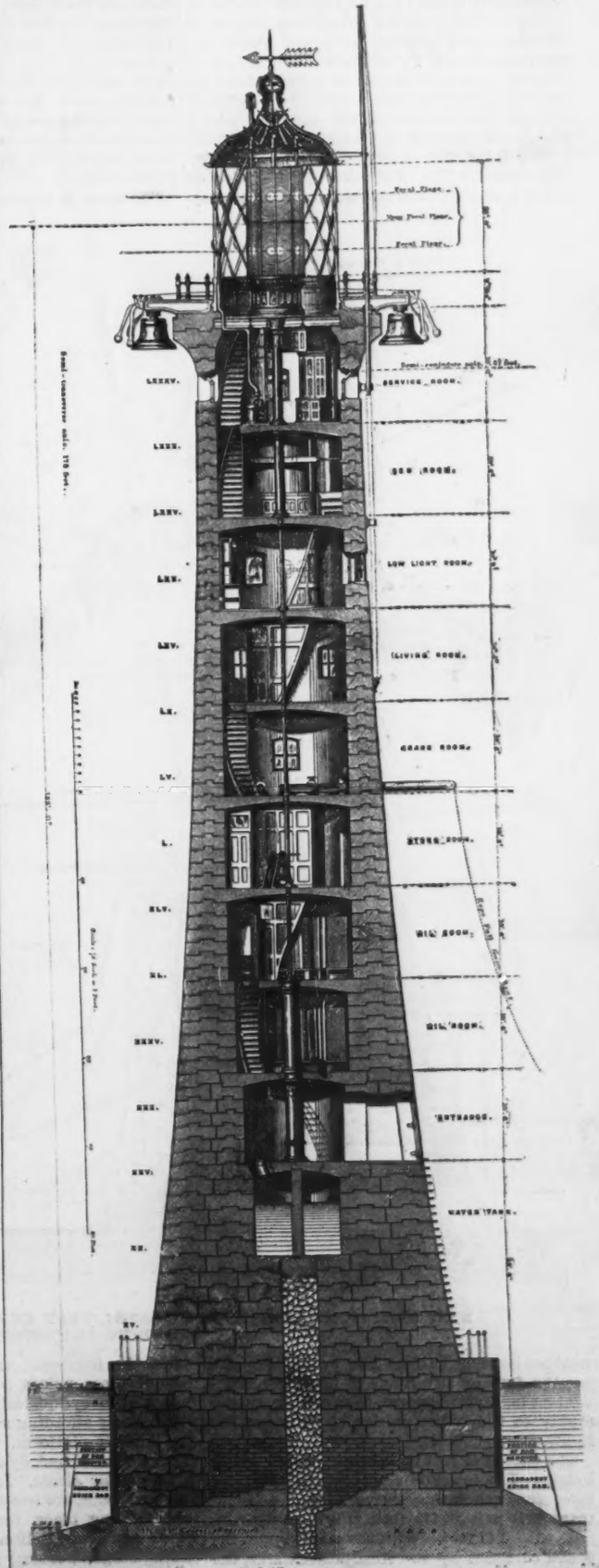
Mr. Thomas Edmond, who had been engaged for several years in the service of the Trinity House in the erection of lighthouses, was selected for the superintendence of the work, and the Author was appointed the Assistant Engineer. The whole work of fitting up the internal arrangements, together with the taking down and removal of Smeaton's lighthouse, was afterward intrusted to the Author, the services of Mr. Edmond being required at another important work.

A suitable site for the workyard on shore was obtained at Oreston, on the River Laira, Plymouth. The site, which is a portion of the premises formerly appropriated for the construction of the Plymouth breakwater, and is now partially used for its maintenance, was kindly placed at the disposal of the Trinity House by the Lords of the Admiralty. Here a temporary timber jetty, workshops, stores, offices, &c., were erected.



8th COURSE (Plate 2.)

The twin screw-tender "Hercules," one of the two steam vessels employed in the construction of the Great and Little Basses Rock Lighthouses, Ceylon, having returned to this country on their completion, was transferred to the station at the Eddystone as the working tender. This vessel (Plate 1), with her special adaptability for lighthouse building, has been described by Mr. William Douglass,



NEW EDDYSTONE LIGHTHOUSE (Plate 2) Section in Line A. A.

*From the Proceedings of the Institution of Civil Engineers.

[1] Minutes of Proceedings Inst. C.E., vol. liii., p. 247.

M. Inst. C.E., in a Paper on the Great Basses Lighthouse.[2]

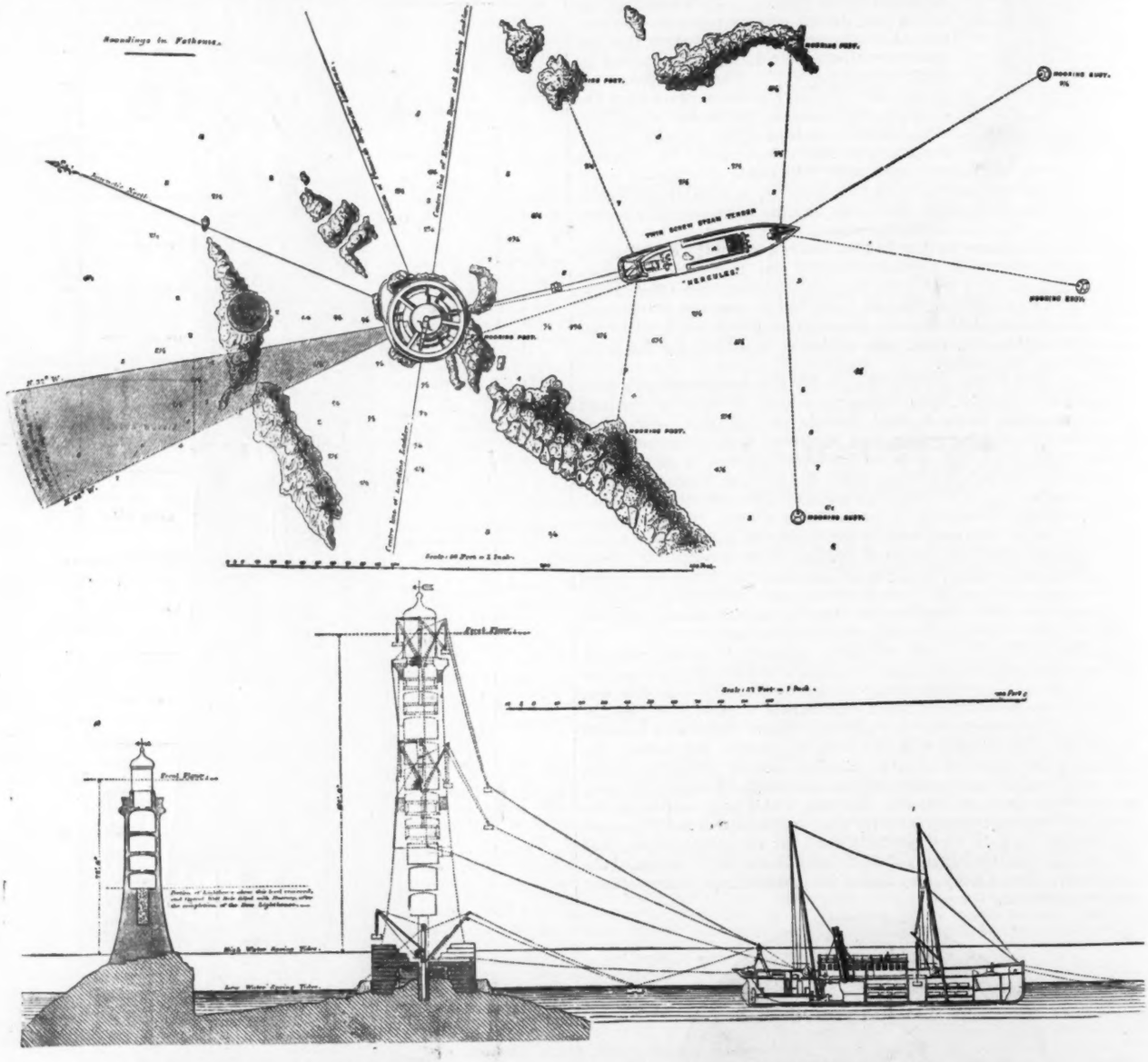
The structures of Winstanley, Rudyerd, and Smeaton having been so fully alluded to by Smeaton in his "Narrative of the building and a description of the construction of the Eddystone Lighthouse," need no further reference.

The tendency of the curvilinear outline of Smeaton's and of other similar sea towers that have succeeded it, to elevate the centre of force of each wave stroke on the structure, induced Sir James Douglass to adopt a cylindrical base for the new lighthouse, from which base, at a level of 2½ feet above high water spring tides, the curved shaft of the tower commences. The difference in the rise of heavy seas on the two structures during stormy weather is remarkable. The cylindrical base has the further advantage of affording a convenient landing platform, thus adding considerably to the opportunities of relieving the lighthouse.

The base is 44 feet in diameter by 22 feet in height. The tower is a concave elliptic frustum, the generating curve having a semi-transverse axis of 173 feet, and a semi-conjugate axis of 37 feet. With the exception of the space occupied by the fresh-water tanks, the tower is solid for 25 feet 6 inches above high-water spring tide level. At the top of the solid portion, the wall is 8 feet, 6 inches in thickness, diminishing to 2 feet, 3 inches in the thinnest part of the service room. All the stones are dovetailed both horizontally and vertically, on the system described by Sir James Douglass, in his Paper on the Wolf Rock Lighthouse.[3] Each stone of the foundation courses is sunk to a depth of not less, at any part, than 1 foot below the surface of the surrounding rock, and is further secured by two Muntz metal bolts, 1¼ inch in diameter, passing through the stone, and 9 inches into the rock below, the top and bottom of each bolt being fox-wedged.

The tower is approached for landing on two sides, the northeast and the southwest. At each of these points, in a recess made in the face of the cylindrical base, are fixed gun-metal cleats affording access for ascending to the landing platform. From this point the entrance is reached by another ladder formed of 25 similar cleats. In the fourth, or store and coal room, are two doors, one directly over each landing place, for receiving the stores, which are hoisted direct from the boat by a sliding crane, working through a port in the tower over each door, and arranged to house within the tower during stormy weather. This crane is also used for landing and embarking the lightkeepers and others, when the sea will only admit of a boat approaching with safety within from 20 to 40 feet of the tower.

The tower contains nine rooms, the seven uppermost having a diameter of 14 feet and a height of 10 feet. These rooms are fitted up with every consideration for the accommodation of the lightkeepers, and the stores necessary for the efficient maintenance of the lights; they are rendered as far as possible fireproof, the floors being of granite covered with slate, the stairs and partitions of iron, and the windows and shutters of gun metal. The two oil-rooms contain eighteen wrought-iron cisterns capable of storing 4,300 gallons of oil, and the water tanks contain, when full, about 4,700 gallons. The section and general arrangement of the lightning conductor are as originally recommended by Faraday. The section is 1½ inch by ¾ inch half-round copper; the rod is carried down inside the tower from the lantern pedestal to the entrance door, and is let in flush with the surface of the walls, to which it is secured at every 3 feet by lead plugs and copper screws, the several lengths being lapped and screwed together at the junctions. The gallery railing, metal floor of the lantern, win-



NEW EDDYSTONE LIGHTHOUSE, (PLATE 1,) PLAN AND SECTION AT LOW WATER SPRING TIDES, SHOWING LANDING AND SETTING ARRANGEMENTS.

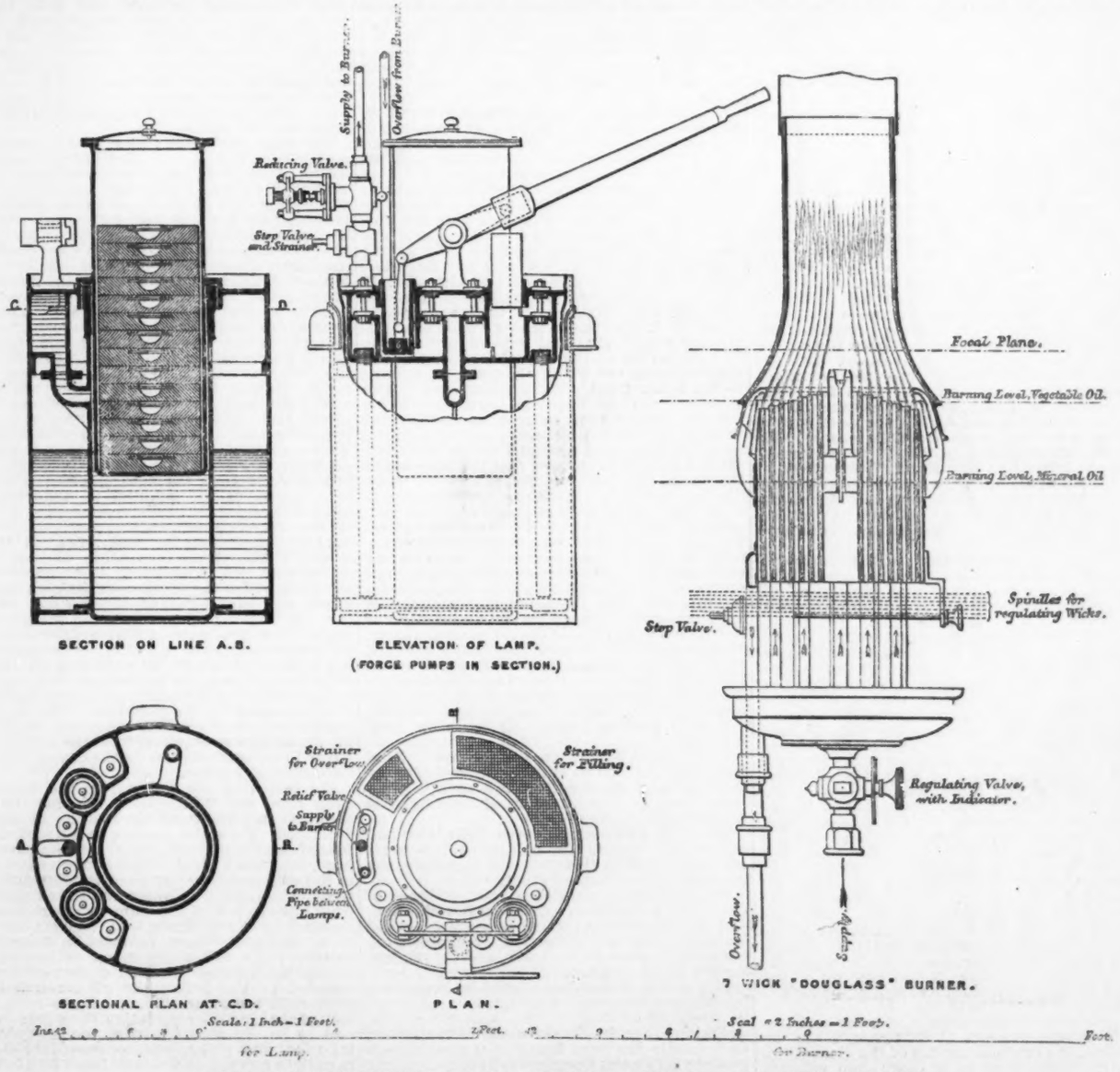
[2] Minutes of Proceedings Inst. C.E., vol. xxxviii., p. 59.

[3] Minutes of Proceedings Inst. C.E., vol. xxx., p. 1.

dows, window shutters, external doors, iron partitions, tanks, ladders, lead pipes, crane, stoves, etc., are all properly connected with the conductor, by copper of the same section. From the entrance door the conductor is continued down the face of the tower to a depth of 2 feet below low-water spring tides.

The masonry consists of 2,171 stones, containing 62,133 cubic feet of granite, or 4,668 tons. Around the wall of the service room is neatly sunk, in the course under the ceiling, the verse of Psalm CXXVII., as adopted by Smeaton on the wall of the oil room of his lighthouse, "Except the Lord build the house they labor in vain that build it."

The lantern is the cylindrical helically-framed houses of Winstanley, Rudyerd, and Smeaton at the Eddystone, the Trinity House determined on substituting as a distinction for this important station, a white double flashing light at half-minute periods, showing two successive flashes, each of about 3½ seconds' duration, divided by an eclipse of about 3 seconds; the second flash being followed by an eclipse of about 20 seconds. It was also determined to show from a window in the tower, 40 feet below the flashing light, a sector of white fixed light, covering a dangerous shoal called the Hand Deeps, which bears northwest from the lighthouse at a distance of 3¼ miles. It was further determined that a large bell should be sounded during foggy weather, and 44½° below it. Each lens-panel is composed of a central lens and thirty-nine annular rings or segments, there being twenty-one above and eighteen below the central lens. The twelve panels in each tier are fitted together so as to form a twelve-sided drum, each lens having its focus in a common centre at a distance of 920 millimetres. These lenses subtend the largest vertical angle of any yet constructed for coast-illumination, the increased angle and consequent additional power being obtained by the adoption of heavy flint glass for the six highest and for the three lowest rings of each panel. The relative efficiency of this section of lens and that of the old section is 88 to 70 nearly, and its effect is only about



EDDYSTONE LIGHTHOUSE (Plate 5,) IMPROVED FIRST ORDER PRESSURE LAMP.

type adopted by the Trinity House, a description of which has already been submitted to the Institution.[4] The glazing is two feet six inches higher than usual for first order lights, this additional height being necessary to meet the requirements of the special dioptric apparatus. The flag-staff (Plate 2) is fixed in a hole cut through the lantern gallery, and in a gun metal guide at the surface of the tower below. At night the flag-staff is lowered by a winch, with which it is provided, so that its truck is below the level of the beams of light issuing from the lantern. For the white fixed light exhibited from the three light-

twice in quick succession every half minute; thus assimilating the character of the sound-signal to that of the light. Two bells of 40 cwt. each are mounted at opposite sides of the cornice, in order that a windward bell may be sounded during fog.

The optical apparatus of the main light consists of two superposed tiers of lenticular panels, twelve in each tier. The section of these lenses was designed by Dr. John Hopkinson, M. Inst. C. E., in 1880, for the Anvil Point lighthouse on the coast of Dorsetshire. Each lens-panel subtends a horizontal angle at its foci of 30°, and a vertical angle of 92°, being 47½° above the central plane of the lens,

12 per cent. less than that of the old apparatus composed of lenses with totally-reflecting prisms above and below it. Various combinations of superposed optical apparatus have been employed in the lighthouses of this country since the application by Faraday in 1843[5] of ventilating tubes to each lamp, for conveying to the cowl of the lantern the products of their combustion. In 1859 Mr. J. W. D. Brown, of Lewisham, proposed superposed lenses for signal and lighthouse-lanterns, with a separate light for each tier of lenses. In 1872, Mr. John Wigham, of Dublin, proposed superposed lenses for lighthouses, and the

[4] Minutes of Proceedings Inst. C.E., vol. xxviii., p. 11.

[5] Minutes of Proceedings Inst. C. E., vol. xi., p. 182.

first application of these, in conjunction with gas-flames, was made by him in 1877, at the Galley Head Lighthouse, on the coast of County Cork. In 1876 Messrs. Lepaute and Sons, of Paris, appear to have made successful experiments with superposed lenses, and the mineral oil flames of one to five-wick lamps, the results of which were given by Mr. Henry Lepaute. Jun., in a paper contributed to the Congress at Havre in 1877, of the French Association for the Advancement of Science.* Messrs. Lepaute and Sons also exhibited an apparatus of this kind at the Paris International Exhibition of 1878. The Eddystone represents, however, the first practical application of superposed lenses of the first order with oil as the illuminating material. Access to the burner is obtained, as in all recent first-order lights of the Trinity House, by a door in the large circular pedestal, and a man-hole in the lamp stage, so that entire control of the manipulation of the lamp or lamps is exercised by the lightkeeper without the usual stoppage of the rotation of the apparatus, and consequent interference with the distinctive character of the light. The lantern and optical apparatus were constructed by Messrs. Chance Bros. and Co., of Birmingham.

The flame of a six-wick "Douglass" burner, with an intensity of 720 candles, is placed at the common foci of each tier of lenses. For these burners others of seven wicks will shortly be substituted, having an intensity of 950 candles. The ventilation of the upper burner is provided in the usual manner, by an iron funnel carried up to the ventilating shaft of the lantern, with a regulating damper. For the ventilation of the lower burner, the funnel is divided into three branches, and these are carried up inside the upper lenses, to the same level as the funnel of the upper burner. Each branch is flattened where it passes the upper lenses, thus reducing to a minimum the obstruction of the light in its passage from the burner to the lenses. It will be observed that the small obstruction of light thus incurred might be avoided by carrying the flues from the lower burner upwards on the outside of the upper tier of lenses, and in the dark spaces between the beams sent from the lenses. This arrangement would probably be necessary with an apparatus composed of three tiers of lenses, to avoid the high temperature created inside them. It was, however, considered preferable in this instance to obviate the further complication of the apparatus that would have been incurred.

As the first application of the improved burner of Sir James Douglass to a coast lighthouse of the first order was effected at the Eddystone, a description of this burner, which is shown in Plate 5, is desirable. The invention consists in surrounding an ordinary deep-chambered Argand, or a concentric-stepped Argand-burner for oil or gas, with two or more concentric deflectors, these deflectors being so arranged, in conjunction with a deflecting glass chimney, as to force, in successive stages, the outer flame or flames on the inner flame or flames, thus condensing them to the utmost extent, and also deflecting on to the external and internal surfaces of each ring of flame, the whole of the ascending currents of air. The initial temperature of the flames is thus considerably increased by the condensation, and the temperature of the ascending currents of air is raised in their passage through the burner to the flames; perfect combustion being consequently produced with a maximum intensity of the light, and a minimum consumption of the illuminating material. With this burner no adjustment of the shoulder of the glass chimney is required, as usual with concentric Argand lighthouse-burners; consequently no alteration is made in the position of the zone of light of maximum intensity, which is generally adjusted to the optical apparatus for direction to the sea-horizon. By the arrangement of the currents of air through the deflectors, the internal surface of the glass chimney is maintained in a clean and efficient state, and the temperature of the glass chimney is considerably lower than ordinarily with Argand burners; thus flames of much greater intensity than hitherto produced can be employed without risk of breakage of the glass chimney. An intensity of nearly 1,500 candles has been obtained with these burners, without damage to the glass chimney, and the intensity per square inch of the sectional area of the flames in the vertical plane is believed to be the highest yet obtained with any burner for oil or gas. The simplicity of construction of the burner, the high intensity and focal compactness of its flame, together with the economy of fuel, combine to render it, in the Author's opinion, the most efficient burner yet produced for any illuminating oil or gas.

* Compte rendu de l'Association francaise pour l'avancement des sciences, 6 Session, p. 223.

The placing of the lamp in the pedestal of the illuminating apparatus affords more room for the lightkeeper in the manipulation of the burner than when set on the lamp stage in the usual way; moreover it is a much safer arrangement as regards fire where mineral oil is consumed.

The improved lamp-reservoirs and pumps for the supply of oil to the burners (Plate 5), two of which are provided, were designed by Sir James Douglass for the Anvil Point lighthouse in 1880. The improvements in these lamps consist in the introduction of a hollow weighted plunger for driving the oil to the level required for each burner; also the application of a double-acting pump for raising the plunger, in lieu of a rack-and-pinion, or a pitch-chain with weights as hitherto. The apparatus is less costly and less liable to accident than the different lighthouse lamps now in use. The only parts subject to wear are the pump leathers, and others are substituted by the light-keepers whenever new ones are required. Two reservoirs and plungers are ordinarily in use, but the light can be maintained by one, so that in case of accident to either, the disabled lamp can be disconnected and sent ashore for repairs.

The driving-machine is arranged for striking the fog-bells, in addition to the rotation of the optical apparatus. The machine is driven by an endless balanced pitch-chain with arrangement for maintaining the power during the process of winding. The driving weights are placed in an iron trunk in the lower rooms of the tower, and are connected with the pulleys and pitch-chain by a $\frac{3}{4}$-inch chain, the latter passing through an iron tube at the centre of the tower. A small "Buckett" caloric engine, of one-half effective HP. is intended to be fixed in the service-room, for relieving the lightkeepers of the excessive strain of driving the machine when both illuminating apparatus and fog-bell are in use. The engine is now under practical trial at the workshops of the Trinity House, preparatory to its being fixed at the lighthouse. The speed of the machine is regulated by a "Slight" centrifugal governor, and is provided with an indicator dial; also gear for rotating by hand in case of accident to the machine. With a clear atmosphere, and the light of the Plymouth Breakwater lighthouse 10 miles distant distinctly visible, the lower burner is worked at its minimum intensity of 450 candles, giving an intensity of the flashes of the optical apparatus of 37,800 candles nearly; but whenever the atmosphere is so thick as to impair the visibility of the Breakwater-light, the full power of the two burners is immediately put in action with the aggregate intensity of 1,900 candles for the lamps, and an intensity of the optical apparatus of 159,600 candles nearly. This intensity is about 23.3 times that of the fixed light latterly exhibited from Smeaton's tower, and about 2,382 times that of the light first exhibited in the tower from tallow candles. The intensity of the light is the highest that has yet been produced from oil for coast illumination.

The optical apparatus for the lower fixed light consists of two 21-inch paraboloidal reflectors, each fitted with a two-wick "Douglass" lamp. The intensity of this light is nearly 12,000 candles.

The focal plane of the upper light is 133 feet above high water. Its nautical range is $17\frac{1}{2}$ miles, and during clear weather it overlaps the electric lights at Lizard Point.

The Eddystone furnishes good evidence of the recent progress in lighthouse illumination, and of the enormous value of perfect optical apparatus for the utilization of illuminants both with regard to economy, and its efficient service for the guidance of the mariner.

The original chandelier-light in Smeaton's light-house was unaided by optical apparatus; it consisted of twenty-four tallow candles, weighing $\frac{3}{4}$lb each. The intensity of the light of each candle has been found from experiments made by Sir James Douglass to have been about 2.8 standard sperm candles, thus the aggregate illuminating power radiating from the twenty-four candles was about 67.2 candle units. The consumption of the candles was about 3.4 lbs. per hour, at the current price of tallow candles, would be about 1s. $6\frac{3}{4}$d.

At the shore lighthouse of the Trinity House, where oil is employed as an illuminant, mineral oil is adopted as being the cheapest, while in point of efficiency it is equal to the best of the vegetable or animal illuminating oils. At the Eddystone, as at other rock lighthouses, as well as on board light-vessels, colza-oil is employed on account of its greater safety in use and storage. For the whole year during which the lamps of the main light at the Eddystone are burning between sunset and sunrise—four thousand four hundred and twelve hours—being about two thousand nine hundred and forty-one hours clear weather, and one thousand four hundred and seventy-one hours thick weather, the cost of the illuminating oil per hour, inclusive of wicks, and glass chimneys, is 1s. $7\frac{1}{4}$d. nearly, being only $\frac{1}{4}$d. more than the present cost per hour would be of the original candle-light at this station of only $\frac{1}{23\frac{1}{2}\frac{1}{2}}$ part of the intensity of the present light.

The first visit of the Engineer-in-Chief and working party was made in the "Hercules" on the 17th of July, 1878. The weather being very favorable, with full spring tides, a large portion of the area was uncovered at low water, and a commencement was made with the work. The site was examined with the view of avoiding any unnecessary removal of sound rock, and the exact positions of the various benchings of the foundation courses were carefully traced out, and permanently pegged for the guidance of the workmen. At the centre of the site a commencement was made in the levelling in benches, of an area having a radius of 10 feet 8 inches, and building in Portland cement, and protected with fresh burnt Roman cement, with small, rough granite ashlar, of 1 to $1\frac{1}{2}$ cwt. per stone (a convenient size for landing from the boats), a central platform and future core for the work. At the centre of this platform a 2-foot well-hole was formed for the central crane, and in this the men worked in sinking the required hole in the rock for suporting the crane.

The platform, raised 10 feet above low-water spring tides, considerably facilitated the earlier stages of the work, as the workmen could land with their tools and materials, in readiness for proceeding with the work to the foundations, immediately the tide had sufficiently ebbed; and, with the flood tide also, they were thus able to continue at work until the last possible moment. Around the foundation, and at a distance of 6 inches from the face of the masonry of the cylindrical tower, a strong cofferdam of hard well burnt bricks and fresh burnt Roman cement was built. Every available opportunity by night or day was seized for getting in this dam. Before laying the bricks, the surface of the rock was well cleaned from seaweed and rough picked, the cleaning being affected, where the rock was exposed, by strong sulphuric acid. The cofferdam was 7 feet in thickness at its base, with a maximum height of 7 feet. Three radiating walls were formed in the dam as shown in Plate 1, these being required: (1) For strengthening the dam; (2) For reducing to a minimum the quantity of water to be ejected at each tide before commencing work; (3) For affording, as they frequently did, a lee dam for carrying on the work, when otherwise it would have been impossible to keep the whole area free from water. For protecting the work whilst the portions of the dam on the south and west sides, at about 2 feet below low-water spring-tides, were being built, heavy bags of concrete were at first deposited along the outside radius of the dam. Occasionally a few courses of brickwork were found to have been washed away on the return of the party to the rock; but fortunately no great damage ever occurred to the cofferdam. Sharp grit-sand of excellent quality, composed chiefly of hard quartz, was obtained from the bed of the River Plym at Plympton for the cement of the cofferdam and tower.

For removing the water from the dams at each tide, the "Hercules" was moored at about 30 fathoms from the rock as hereafter described. From the steamer to the rock were passed two 3-inch india-rubber canvass-covered hose, internally wired. These were connected to the double-acting pumps of the fore-and-aft steam-winches. The water was thus removed from one section of the dam by steam power, assisted by the workmen with buckets on the rock, in about fifteen minutes in favorable weather; the full complement of men then started work whilst the other dams were being emptied by the hose. As no blasting was allowed in removing the superfluous rock, for fear of shaking the foundation, the whole work had to be executed by drills, jumpers, cleaving-gear, and picks, and, as each face-stone is sunk to a depth of not less than 1 foot below the surrounding rock, a considerable amount of labor of this description had to be performed. This portion of the work was considerably facilitated by the use of two of the "Eclipse" rock-drills of Messrs. Hathorn and Co., which were very efficient, and needed little repair. These drills were driven by compressed air at a pressure of 80 lbs. per square inch, supplied through a flexible hose from a pair of compressors on board the "Hercules."

For landing stone the "Hercules" was moored at about 30 fathoms from the rock, as shown in Plate 1, by 10-inch coir hawsers ahead to three iron spherical buoys, moored with $1\frac{1}{4}$-inch open-link chain, and 40-cwt. cast-iron sinkers, and astern to iron posts on the surrounding rocks. The end of each hawser was provided with a chain for fastening to the ring of the buoy, and to this was attached a tripping line, for use in case of rough weather coming on suddenly, when the whole of the

hawsers could be let go from the vessel without any aid from a boat.

A hollow wrought-iron mast, 25 feet in length and 16 inches in diameter, was firmly wedged in a hole at the centre of the tower, sunk 5 feet into the solid rock, and stayed by ¾-inch guy-chains. Two jibs were attached to the mast, one of wood for landing the stones, and one of iron capable of travelling around the mast for setting. The wooden jib at the early part of the operations was lowered and taken off at the end of each tide's work, to avoid its being damaged by the sea; but the iron jib was lowered and securely lashed to eyebolts on the structure, and its winch stowed in the central hole, or removed on board the "Hercules" to avoid all risk of its being broken or lost. As the work progressed, the iron mast was lifted by hydraulic jacks and secured to the structure by timbering and chain back-guys. A hollow wrought-iron topmast, 19 feet in length, was fixed, after the second season, to obviate the frequency of lifting.

The "Hercules" being safely moored in her berth at the rock, the stones were lifted from the hold by the forward steam-winch and deposited upon a truck, which ran on metals to the stern of the vessel, where a strong timber gantry was erected; and wooden rollers were fitted on the deck at the stern gangway for carrying the stones clear of the stern of the vessel without damage. The stone standing on the truck under the gantry at the stern, was landed by the after double-barrel winch in the following manner: A ⅝-inch chain-fall was passed from the starboard winch end, through a leading block at the side of the gantry, and thence successively to a leading block at the heel of the landing mast, next to a block attached to the head of the landing jib, then to a single block shackled to the lewis of the stone, and finally to the head of the landing jib, where it was made fast. A second chain, ⅝ inch, was passed from the port barrel of the winch over a strong sheave fixed on the top of the gantry, and shackled to the lewis of the stone. On the starboard barrel of the winch being put in motion, and the chain-fall fairly tightened, the stone was lifted clear of the truck by the port barrel, and then eased away by a break as the stone was hauled on shore. For landing the stone on the tower, a strong luff-tackle was attached at one end to the mast of the crane, at about 11 feet above the level of the top of the masonry. Immediately the stone was hoisted well above the top of the work, the hoisting winch was stopped, and the luff-tackle was promptly hooked to the sling of the stone, and the end of the tackle-fall was made fast. The signal to lower was then given, when the stone was immediately landed on a strong coir mat placed to receive it. The stones, weighing from 2½ to 3½ tons were transported between the stern of the vessel and the tower in two-and-a-half to three minutes. On being landed they were removed by the traversing-jib to their several positions, and set by hand. Three of the positions of the crane, which worked successfully throughout, are shown in Plate 1. Thus every stone in the building, together with the required cement, sand, water, etc., was landed and hoisted on to the work at one lift from the "Hercules." This is probably the first application of floating steam machinery to the actual erection of a structure at sea.

By June, 1879, the work was sufficiently advanced for the stones to be laid in the foundation-courses, and everything was arranged for H.R.H. the Duke of Edinburgh, Master, who was to be accompanied by H.R.H. the Prince of Wales, Elder Brother, of the Trinity House, Hon. MM. Inst. C.E., to lay the foundation stone on the 12th of the month. The weather had been rough for many days previous to the one set apart for the ceremony, but hopes were entertained of its clearing up. When, however, the morning broke, the wind was blowing a gale from the southwest, and a landing at Eddystone was impossible. Not to be disheartened their Royal Highnesses determined on making another attempt to lay the foundation stone, and August the 19th was the second date selected for the ceremony, other portions of the work to the foundations being in the meantime proceeded with. Fortunately the weather proved more propitious on the latter occasion, the wind being moderate from the southwest, and the sea fairly smooth.

On the arrival of the Royal party at the rock, the dams had been pumped out, and the stone, weighing 3½ tons, landed in readiness. A bottle containing a parchment scroll, with full details of the work, having been placed in a cavity under the bed of the stone, and the cement bed properly prepared, the stone was lowered into position, adjusted and bolted by the Master of the Trinity House, assisted by the Prince of Wales. The stone was then declared "well and truly laid" by his Royal Highness and Master. After this, favorable weather was experienced, and the work was carried on until the latter end of December, one hundred and thirty-one landings having been effected, work carried on for five hundred and eighteen hours, and one hundred and fourteen stones set in courses, 1, 2, 3, 4, 5, 6 and 7, being an average of 3.95 hours of work at each landing.

Work was again commenced at the rock in March, 1880, and rapid progress made. On the 17th of July, two years after the outset of operations, the whole of the cylindrical base was completed, and early in November, the end of the season, the 38th course of masonry was set. The weather setting in rough, work was then suspended until the following year. During this season one hundred and ten landings had been effected, six hundred and fifty-seven hours spent in work, and one thousand four hundred and thirty-seven stones set, the average number of hours of work per landing being 5.97.

Next season (1881) work was commenced in the middle of January. The top of the structure being well above the wash of the sea, the tools could be left behind and more rapid progress made.

As soon as the sixth room was completed, workmen were lodged in the tower, which further facilitated progress, since, during the absence of the steamer and working party, the central crane was lifted and adjusted, and things generally placed in readiness for the next day's operations. On the 1st of June, the Duke of Edinburgh, when passing up Channel in H.M.S. "Lively," landed at the rock, and laid the last stone of the tower. Thus the whole of the masonry was landed, hoisted, and set within two years. During this season forty landings had been effected, work carried on for two hundred and ninety-four hours, and six hundred and twenty stones set, being an average of 7.35 hours of work at each landing.

On the completion of the masonry a full complement of workmen were stationed in the tower to carry out the internal arrangements and fittings. The lantern was erected before winter set in, and early in the following year a temporary catoptric fixed light, consisting of twenty-four 21-inch paraboloidal reflectors and Argand lamps, was installed in the lantern of the new tower, and the light of the old one was discontinued on and after February 3, 1882. The optical apparatus for the upper and lower lights were meanwhile set up in the new tower. On the 18th of May the Duke of Edinburgh completed the work by lighting the lamps and formally opening the lighthouse. The edifice was thus completed within four years of its commencement, and one year under the time estimated.

The author had opportunities during the previous winter of witnessing from the lantern of the new tower the action of heavy seas on the two structures. The waves, striking the old tower at its foundation, ran up the surface with great force, unimpeded by any projection until arriving at the lantern gallery, where they were partially broken up by the cornice, and then expended themselves in heavy spray over the lantern, which entirely excluded from view, for the space of half a minute, any portion of the tower or lantern. It will be observed that this description closely resembles the illustration given on the title-page of Smeaton's narrative of the building of his lighthouse. At the new tower, the heavy seas striking the cylindrical base were immediately broken up, and rushed round to the opposite, side sprays only ascending to the height of the lantern gallery.

During this winter an iron cannon, about 6 feet long, and 3 inches bore, weighing 10 cwt., was found at the base of the new lighthouse, having been washed up there from deeper water. It is supposed that this gun may have been one of those carried by the "Winchelsea," which was wrecked on the Eddystone rocks, shortly after the destruction of Winstanley's lighthouse.

The granite for the new tower was supplied by Messrs. Shearer & Co., of Westminster, from their quarries of Dalbeattie and De Lank. The blocks were delivered at the workyard at Oreston, dressed and fitted for the structure. On the completion of the solid portion of the tower, the supply from the Dalbeattie quarries was discontinued, and the whole of the remainder of the tower supplied from De Lank.

The Portland cement was supplied under contract by Messrs. Francis & Co., of Nine Elms. Sample briquettes having a sectional area of 1½ inch by 1½ inch immersed in water immediately after setting, were required to stand a tensile strain of 350 lbs. after two days' immersion in water, 500 lbs. after four days, and 750 lbs. after seven days. So well did the manufacturers meet this condition, that none of the samples taken at random from the deliveries broke below the strains stipulated, and the average strain of the samples broken exceeded them by 16 per cent. The Roman cement for the brick cofferdams was manufactured from selected stone, and supplied fresh of excellent quality, as required from time to time, by Messrs J. and T. Harvey of Plymouth.

The Town Council and inhabitants of Plymouth having expressed a desire that Smeaton's Lighthouse should be re-erected on Plymouth Hoe, in lieu of the Trinity House seamark thereat, the Corporation of the Trinity House, who, as custodians of public moneys, had no funds available for such a purpose, undertook to deliver to the authorities at Plymouth, at actual cost for labor, the lantern and four rooms of the tower. These are now being re-erected by public subscription on Plymouth Hoe, on a frustum of granite, corresponding with the lower portion of Smeaton's tower, and it is to be hoped that it will ever be preserved by the town of Plymouth as a monument of Smeaton's genius, and in commemoration of one of the most successful, useful, and instructive works ever accomplished in civil engineering.

For taking down and shipping Smeaton's masonry, the upper portion of the iron crane used in the erection of the new tower, was fixed in timber partners, in the centre of the upper rooms after the removal of the lantern, and the crane-post provided with a lowering and traversing jib. The taking asunder of the stones of Smeaton's work, in such a manner as to fit them for re-erection, was, as may readily be conceived, a very difficult and tedious operation. For shipment the "Hercules" was moored at about 10 fathoms westward from the rock, and the stones were taken on board with the aid of her machinery, by a process exactly the reverse of that by which the stones of the new tower were landed. On removing the stones of the gallery course, where the salt water had been driven through the joints of the masonry, previous to the reduction of the projection and the bolting down of the cornice in 1865, a thick deposit of salt was found on the upper surface of the cement bed of each stone. After the removal of the lantern and internal iron ties, and whilst the workmen were lodged inside the tower, a strong gale of wind and heavy sea from the westward was experienced Such was the effect of the wave-strokes on the building, that a tumbler of water standing on the table in the living-room was thrown from it. After the removal of the structure to the floor of the lower room, the entrance doorway and well staircase leading from it to the lower room were filled in with masonry. An iron mast was fixed at the centre of the top of the frustum, and strong gun-metal cleats were let into the face of the tower for access to the top. It is to be hoped that the rock below will for ages endure to support this portion of Smeaton's lighthouse, which, in its thus diminished form, is still rendering important service to the mariner, in giving a distinctive character to the Eddystone by day.

It is a source of thankfulness to the Author to state that this dangerous work has been carried out without loss of life or limb to any person employed. He has further pleasure in stating that it has been completed at a cost considerably under the estimate of the Engineer-in-Chief. The total cost of the work has been £59,255, being £18,745, or 23½ per cent. below the estimate.

The low cost of this work is mainly due to the successful operation of the various mechanical appliances introduced by the Engineer-in-Chief for saving manual labor, and facilitating the progress of the work. Any comparison of its cost with similar structures which have preceded it in this country, can only be considered as approximate, owing to the ever-varying circumstances of each particular case. The Author has, however, submitted the table of comparative cost, furnished by Sir James Douglass in his Paper on the Wolf Rock Lighthouse,[7] to which he has added the new Eddystone and two other rock lighthouses erected since the Wolf Rock Lighthouse. From the Table it will be seen that the cost of the new Eddystone per cubic foot is lower than any similar structure yet erected.

Name of Structure.	Total Cost.	Cubic Feet.	Cost per Cu. Ft.
	£ s. d.		£. s. d.
Eddystone (Smeaton).....	40,000 0 0	13,343	2 19 11½
Bell Rock.....	55,619 12 1	28,530	1 19 0
Skerryvore.....	72,200 11 6	58,580	1 4 7½
Bishop Rock.....	34,559 18 9	35,209	0 19 7½
Smalls.....	50.124 11 8	46,386	1 1 7½
Hanois.....	25,295 0 0	24,542	1 0 7½
Wolf Rock.....	62,726 0 0	59,070	1 1 3
Dhu Heartach.....	72,544 9 7	42,050	1 14 6
Longships.....	43,869 8 11	47,810	0 18 5
Eddystone (Douglass).....	59,255 0 0	65,198	0 18 2

[7] Minutes of Proceedings Inst. C. E., vol. xxx., p. 28.

Engineering News

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, - - - New York City.

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PUBLISHED EVERY SATURDAY.

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TERMS OF SUBSCRIPTION:

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$5.00..... " " " FOREIGN COUNTRIES.

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ON and after May 1st, the principal office of the Davidson Steam Pump Co., will be at 77 Liberty St. New York, where all communications should be addressed after that date.

PARTIES in search of back numbers of ENGINEERING NEWS to complete volumes, are especially referred to Page X of advertising for April 12th and succeeding weeks. It is quite out of the question for us to start up a trade in old files of our paper; our time is too limited to attend to it, and it is an exceedingly unprofitable kind of business besides. We will advertise these exchanges this month and subscribers must correspond directly, and not through us; after this month we think that it will not be necessary for us even to reply to inquiries for numbers previous to the current volume.

THE next meeting of the American Institute of Mining Engineers will be held at Chicago, beginning Tuesday, May 27. The following programme is provisionally announced: Tuesday evening, opening session; Wednesday, excursions to South Chicago and Pullman; Wednesday evening session; Thursday, excursion to La Salle and other points; Friday morning and afternoon, sessions; Friday evening, banquet.

The hotels in Chicago will probably be crowded; and members desiring hotel accommodations should write *at once* to Mr. JOHN CREERAR, JR., 109 Dearborn Street Chicago.

Headquarters will be at the Grand Pacific Hotel. Board, from $3 to $5 per day, according to rooms.

Members expecting to attend the meeting should notify the Secretary (Box 223, New York P. O.) at an early day. Arrangements as to railway facilities, etc., will be hereafter communicated to those who have so notified the secretary.

Ten Years of an Engineering Journal and What it Has Had to Tell.

Ten years have passed since the issue from an office in Chicago, Ill., of the first number of ENGINEERING NEWS, bearing date of April 15, 1874. This journal has now entered the second decade of its existance, and we believe we cannot better signalize that event than by giving our present readers a short sketch of its journalistic life, and of the engineering progress made within that time.

Its founder, editor and proprietor was a practising surveyor in the city named, and naturally his journalistic efforts were originally directed towards the discussion of subjects with which he was most familiar. *The Surveyor and Engineer*, as the first paper was called, was a monthly publication, addressed principally to the class first named in its title. The capital upon which it was started was hard work, great personal enthusiasm, perseverance and an abiding faith in the possibilities of an engineering newspaper. The first year's work was all up-hill, filled with the struggles and trials only known to those who have attempted the task of starting a technical journal under similar circumstances; and the total outcome was a modest volume of 168 pages.

The second year was but a repetition of the first, and the chief and only gain was in experience. The surveyors not responding to the extent expected, the title of the paper was changed to that of ENGINEERING NEWS, and the contents selected accordingly.

In 1876 a bold stroke of policy was determined upon, and the paper was issued weekly instead of monthly; this was rather a venturesome experiment and considerable external propping was required to keep the tottering infant on its feet. But it grew, the long-looked for support came at last, slowly but surely, and in 1878 the puny infant of 1874 was able to walk alone; in other words it was not until the year last mentioned, that the paper was practically self-supporting.

The headquarters of ENGINEERING NEWS were now removed from Chicago to New York, the chief purpose being to get nearer the great centre of information, the fountain-head of all new projects, and into the vicinity of some of the most prominent men engaged in the profession of Civil Engineering. The move was a wise one, and from it dates the prosperity of this journal.

Standing before us are the bound volumes representing the infancy, youth, and robust present, of the ten years of our existence; and a comparison of the first thin quarto of 168 pages with the last two bulky volumes of over 600 pages each, which represent the work of 1884, very graphically exhibits the substantial progress made in that time.

Our aim has been, in all these later years, to issue an engineering *newspaper*, and not to supplant the text-books of our technical schools by publishing long mathematical or abstruse technical articles; we have sought to give the hard-working engineer all the professional news that would be interesting to him, but in a condensed state; to give as much that was of practical, solid value as was possible. How well we have succeeded in this policy we must leave our readers to judge.

In the business management, which refers particularly to the advertising pages, we have been rather conservative, preferring the sound, prompt-paying, long-staying and full paid patronage of well-known and substantial firms, to the swelling of pages due the indiscriminate gathering of apparent business "at any price." In support of this, we can point with pardonable pride to the character of the patrons of our advertising pages.

We claim, too, that we have done some service to engineers outside of the publication of a weekly paper, in these past ten years. We have put into their hands an edition of 500 copies of a book, *Humber's Water Supply*, that could otherwise only be obtained for its English price of $60; yet we gave it to them for one-sixth that amount, and in a shape equally good, in some respects superior, to the original. The American engineers have the profit, we made none; our reward was the gratification of placing upon many a book-shelf a copy of a valuable work, issued at a price prohibitory to the most of the engineering fraternity. Just so with Latham's *Sanitary Engineering*; nearly 3,000 engineers have us to thank for a copy of an English work, distributed free to each subscriber of 1877, and the balance of the edition afterward at one-sixth of the English price. We have published and circulated the most complete set of *Statistics of American Water-works* ever issued, and are still gathering material as the subject rapidly grows.

In turning over the leaves of our ten volumes a very fair resumé is presented of the engineering progress of the period covered, the record becoming more full as the pages grow in number. We fail to see where, in any other American publication, as complete and consecutive a record of events interesting to engineers generally can be found. In fact, if we can judge from frequent references to ENGINEERING NEWS in municipal reports and technical papers, that journal alone has preserved, in an accessible and detailed shape many items of public interest.

Born in a year of unsurpassed financial depression, and spending its youth in the following years of forced economy and reduced expenditure for public works, there was but little of interest to record in its callow days; the paper has grown in fact, with the renewed growth and vigor of the country.

But great events have happened in the engineering world since its birth, and of all these some notice, more or less extended, will be found in the pages of ENGINEERING NEWS. In 1874, our railroad mileage had swollen from 35,085 miles, in 1864, to a total of 72,623 miles, doubling in ten years; in this phenomenal growth civil engineers profited and multiplied, but only to suffer the more from the forced idleness of 1874. But now we have over 113,000 miles of iron way, belting the length and breadth of this broad land of ours. Two more roads, the North and South Pacific unite the great oceans, and a third is well under way in the Canadas; the City of Mexico has an all-rail communication with the States; great trunk lines have multiplied; and all this since 1874.

The St. Louis bridge was opened in 1874 only to be surpassed by that over the East River in 1883; the Mississippi Jetties have been built; the Kentucky Bridge, with its daring leap over a gorge 276 ft. deep has been eclipsed by the Viaduct at Kinzua, with its 302 ft. of airy height. Long tunnels have been driven seven miles underground at Baltimore, two miles under the sea at Boston; through the Rocky Mountains, and wherever nature presented a barrier that the engineer found in his way.

The Panama Canal is now a practical reality, the routes via Panama, San Blas, Nicaragua, and Tehauntepec, have been surveyed, and discussed and re-surveyed; but that lusty Frenchman, de Lesseps, has evidently come to the Isthmus proper to stay, and make good his promise that in another four years he would mingle the waters of the Pacific with the Atlantic at Colon. And in passing we will say that our pages give the fullest English record of all that has transpired in that region.

Since 1874, sanitary engineering has become a recognized and, what is more to the point, a practical profession in America, enlisting some of our best engineering talent, and doing, as at Boston especially, some of our boldest engineering work. Towns that never dreamed of such a luxury ten years ago, must now be drained and sewered. A special class of experts has sprung into existence, who regulate the interior fixtures and arrangements of

our houses, to the ends that the air we breathe may be less poisoned, and our conveniences increased at less risk to our lives; that the children in our schools may have more breathing room, and the poor in our tenement houses have life made less miserable.

Sewage-disposal is the knotty problem given these experts, and the satisfactory solution of this question is not yet within their grasp. Very pretty theories have been advanced, and from irrigation to chemical treatment, each plan has had its able advocates, but to-day it is the mass to be handled that appals them, makes the future uncertain, and turns aside all theory. Take London with a discharge of 440 tons per minute, of a material that is even now creating plague-spots in the lower reaches of the River Thames, and well may the engineer ask "what will you do with it?" Our own Boston has spent $6,000,000 to pour this filth into the sea, but every city is not as well situated, or as well disposed to put the axe to the root of the evil.

With the increased desire for the luxuries of life, and with the demands of modern sanitation, the construction of water-works has multiplied to an extent hardly appreciated by the general public. A simple list of the new works commenced and old works extended, within the past ten years, fills columns in our index. Every hamlet from Maine to Texas, must have its public supply, and every large city is crying for more water. The City of New York, with 90,000,000 of gallons daily already at its disposal, is about spending untold sums to increase that supply to 200,000,000 per day; to do this a dam 100 ft. higher than the highest now existing in the world will be required, and 32,000,000,000 of gallons of water be held in reserve. The hydraulic engineers have invented meters, and waste-detectors, and experimented in many different ways to economize in the public distribution of a fluid that the good people can now consume faster than the engineers can supply.

For the other events, in an engineering way, that have taken place in America between 1874 and 1884, we can only give a hasty glance over our index columns. As late as 1877 the telephone was regarded somewhat as an interesting scientific toy; very interesting, but hardly susceptible of public utility, its stock went begging without takers. Electric-lighting was yet in an experimental stage, ten years ago, and its capabilities for lighting streets, and firing buildings, ornamenting street-poles, and shocking cab-horses, only a dream. Cable-roads had not yet supplanted the hard worked horse on the street railways. The elevated railways of New York, that now carry 100,000,000 of passengers per year, and have brought distant real estate into the market, and materially aided in increasing our numbers, our prosperity and our conveniences, were only a few short years ago, scouted as the visionary schemes of designing speculators; as instruments of destruction to life and property, and the exterminators of the surface traffic which they have actually increased. The new Niagara Bridge is the latest of our engineering achievements.

If we go abroad for engineering information we find the last decade teeming with vast projects, many executed, others only discussed. Since 1874, the St. Gothard Tunnel has been completed, and latest of all, the Arlberg. The relative progress made per year in the three longest tunnels in the world, including the Mt. Cenis, is in itself a marked index of the progress made by engineers. The Mt. Cenis finished in 1871, was driven at the rate of 3,637 ft., the St. Gothard pierced in 1880, 5,474 ft., and the Arlberg in 1883, the rate of 7,080 ft. per year; in the same degree the cost of construction decreased from $2,000 per *metre* for the first, to $750 per *metre* for the last. All this is practically due to the improved methods of modern scientific engineering.

In England two great tunnels are under construction, one practically finished, under the Mersey, the other still in progress under the Severn. A ship canal to Manchester, and a tunnel under the channel to France, have both been projected, and in both cases the way of the engineer was blocked by political considerations, and not by Nature's forces. One Tay Bridge was destroyed, and another and greater has been commenced. The Forth Bridge, now building, is to carry its traffic over iron spans of 1,700 ft.

The last decade has been remarkable for canal schemes; ancient Greece is being divided at Corinth; a second Suez is to be built; the Valley of the Jordan has been in danger of being forever buried, and the Dead Sea made a tradition; Africa was to have its Inland Sea, and short cuts to the world's commerce made at every feasible point.

The motto of the day is progress, rapid, radical and daring: judging only from the ten years past what can we *not* predict for the near future?

But we must call a halt in the review of our index pages, the task is somewhat too extended, for the simple table of contents of the last volume alone takes up nearly 5,000 lines of type.

One feature of Engineering News that we have not yet touched upon, is that of personal engineering items, both of individuals and societies. Started originally as the official organ of the Western Society of Engineers, it soon extended its notices to all the engineering societies, giving full records of their meetings and transactions. Together with these notices will be found each week, for the years past, a column of Personals, detailing appointments, promotions, movements, and death, of every engineer coming under our notice in a very extensive list of exchanges from all parts of the country. If any engineer feels slighted from a want of mention under this heading he must charge the fact to his own proverbial modesty; we never saw the event he would have recorded in print.

We look forward very hopefully to the future; for, with the paper on a sound, paying basis, with increased capital and the valuable experience of the past, we see no reason why the rate of growth should decrease; it should rather increase. We recognize our shortcomings of to-day, (did we not, there are plenty ready and willing to remind us of them,) and we mean to improve upon present methods as we grow, until we have an engineering newspaper that will be a model of its class in every respect. Capital alone will not build up a first class engineering paper; experience and long service with the men represented will only teach us their many and peculiar wants and tastes. Engineers are rather an odd class to cater to; one wants water, another railroads, this one advocates the French metre, that one adheres stubbornly to the English inch; one section delights in wading through abstruse formulæ and the higher mathematics, and another very respectable class wants only solid matter-of-fact items. The medial line that a successful publisher should follow is consequently difficult to locate, and requires a deep and long study of his clientale. We have passed through this experience, and in the past have made many blind departures, running tentative lines only to return upon our tracks and branch out anew; we believe we now hold the key to the position, and we mean to use it.

Professor Palmieri devised a process for silvering glass by means of the reducing action on the salts of silver, which is said to have the advantage of producing a very brilliant metallic deposit. When into an ammoniacal solution of nitrate of silver is poured, first, a little caustic potash, and then a few drops of glycerine, the reduction begins at once: and this action is accelerated if ether or alcohol be added to the mixture. A moderate heat and darkness are said to increase the brilliancy of the precipitate, and darkness also favors the adhesion to the mirror of the deposit.

CONSULTING ENGINEERS.

We have a certain class of non-professional correspondents who seek gratuitious advice upon the details of water-works construction, the type and cost of bridges, opinions upon competitive designs and a variety of like engineering conundrums, that it is hardly within our province to answer. And were we ever so well disposed, an intelligent reply could rarely be given upon the data furnished. We would respectfully refer these gentlemen to a certain responsible, intelligent and experienced class of professional men, known as consulting engineers, who are located in every large city and have cards in every class paper. It is their especial business to give advice upon just such questions as are referred to above, but they will expect some return for the knowledge and experience thus dealt out.

It is customary to pay the lawyer for legal advice and the doctor for his prescription. But by some freak of human perversity, the engineer is generally accredited with such exceeding and uncommon good nature that he is supposed to give freely of his ripe experience, an experience that is his sole capital gained only by long years of patient study and hard work. This want of appreciation of the value of an engineer's services, both to himself and to the party he serves, is certainly unreasonable, but is at the same time popular, if we can judge from the methods adopted by the average local board or commissioners. The cheapest engineer, or no engineer at all, is the rule rather than an exception. Advice upon structural work of any description, to be valuable, must come from an acknowledged expert, a man who has devoted a life to the close study and practice of his profession. And in no profession is an experienced man more worthy of a round and substantial fee. The unskilled official may cost his employer tens and hundreds of thousands by his lack of knowledge, by faulty construction or improper location, and pave the way for as much more in prospective damages. The employment of a true expert will avoid all this; even if the pay roll should be somewhat swelled thereby the true economy will appear in the end.

Upon the question of what constitutes an expert, we might first say that a gilt sign or a degree of "C. E." from some technical institution most emphatically does not. While the preliminary training of a school has great value in the more rapid advancement of the earnest student in his future profession, he is simply upon the threshold of his life's work when he leaves that school. To become an expert requires careful observation, long practice, hard study and the digestion of many a tough practical problem, solved upon the Earth's surface instead of a blackboard. The expert is not born, he must be made.

Nor is an acknowledged engineer necessarily an expert, that is, a man professionally fitted to give valuable advice upon the intricate points of his especial field of study. Circumstances or a lack of personal push may keep an engineer in a rut; he may thoroughly understand his every day work, but can not see beyond the narrow limits of his personal practice; in a word, he is unfitted for the task of grasping generalities and passing judgment upon alternative or competitive schemes; he can not properly advise as to the best of several contrasting projects; in short he is not the man to consult.

Engineering as a profession is now too wide for any one intellect to grasp it as a whole, and it is necessarily subdivided into special branches. But each branch has its experienced men, ready and willing to give advice, so that the entire field can be covered when occasion requires. With valuable advice to be had for the seeking, we can but condemn the false "economy" that either begrudges the fee demanded, begs the advice from his neighbor or does without it altogether.

THE INDUSTRIAL SITUATION.

A second series of reductions in the wages of labor is sweeping over the country this year, and a further downward tendency in prices for nearly all staple products is at work. Restriction of production is in progress in nearly every department of industrial activity. As an outgrowth of lower prices and insufficient demand, there is a general movement toward a combination of industrial interests to control production and competition and conserve trade and manufacturing interests. Combinations have been talked of in many directions when a unity was found impossible. The impression prevails quite generally that the volume of business will not be in excess of last year's volume, and that the margin of profits, notwithstanding the reductions in cost of labor and material, will not be as satisfactory. No very heavy enterprises have been presented recently to capitalists or to manufacturers. Railroad building is not as actively prosecuted.

The export trade in staples is light. Cereals are abundant at all points. Capital is waiting for employment. Rates on money are low. Mills and factories are not fully employed. Labor is far from fully engaged. Failures keep inside of safe and anticipated limits. Investments are made with undue caution. Dividends in manufacturing corporations are moderate. Speculation in all channels is at a low ebb; enterprise is taking a short nap. The controlling spirits are waiting for the country to recuperate, or the over-much talked of uncertainties of a presidential year to pass by.

It is evident that business interests are entering an era of dullness, quietness, but not necessarily of uncertainties. The railroads will prove to be the great conserving factor. They will attract, like a magnet, the tide of discontented humanity from foreign lands, and the restless humanity along the Atlantic Coast States desiring wider opportunties. The great West and South will fill up, and in time draw upon the producing capacities of the North and East, for what they have to make and sell.

The equalization of population over the face of the earth is the great problem in the way of almost unobserved solution. Pent up Europe will unload her surplus population in all quarters of the globe through the medium of steamship travel and railroad travel. The overcrowding of Europe has resulted in a congestion of humanity which is now in process of correction. The artificial representation of force which these artificial and unnatural conditions and surroundings has sustained is now being removed by opportunities for cheap travel. Emigration will gradually and rapidly correct the evils of an overcrowding of population. Land will be the cry of the people who have never known what the possession of land meant. Society is on the eve of a development as a natural sequence of this dispersion akin in many respects to the dispersion of population in the early centuries of the Christian Era.

Reference to this great fact is made simply to fully and properly comprehend the great controlling factor in our civilized town, viz.: the effort of the human mind to seek conditions wherever the greatest possible opportunity for development will be enjoyed. The engineer is the pioneer in this new activity. He has already begun to prepare the way for this movement of the people, out of the crowded into the thinly settled sections.

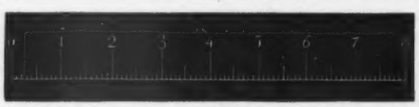
The cutting of canals, the building of long lines of railway between countries, the opening up of cheap and rapid methods of travel, the devising of more economic methods of transportation, all indicate the progress of preparation for the great overflow that is soon to take shape. The engineer has a great work to do in preparing the waste places of the earth for occupancy, and in increasing the enjoyableness of the older sections for those who fortunately are not obliged to seek new homes and opportunities. These hopes are based upon actual necessities of the human mind. What is a hope to-day, will be a realized fact to-morrow. Wild projects to-day are listened to to-morrow, accepted next day, and undertaken the day after. The present dullness will soon be forgotten under the pressure of new necessities and vaster requirements, which will stimulate the latent and partially developed activities of the mind.

SCALES OF PLANS.

"There is reason in all things, even in scales," said one of our leading engineers. Even there, however, reason is too often lost sight of.

In English literature the word scales has the meaning of ladder, from which it naturally gets applied to a gradation or series, and to the graduated wooden, metallic, ivory, or paper scale, with which a draughtsman makes his measurements on a drawing. A fac-simile of this implement, a line graduated to show the units of measure involved, ought to be drawn, as everybody knows, upon all drawings of any importance or permanent value; such a line is called a scale. Yet not everybody does as he ought.

Everybody knows that an embarrassing variety of scales has been used. The obvious way to secure a better state of things hereafter, will be to use only scales in which there is some reason, and to abandon the numerous unreasonable ones. A reasonable scale is one, whose spacing matches the standard divisions of bench-rules, pocket-tapes or other implements in common use for measuring small distances. For instance, the scale herewith given is tolerably convenient, because everybody has at hand, some measure with marks corresponding to the marks below; hence anybody could



slip his own measure about upon a plan having that scale, and could make measurements in the same manner as a draughtsman would with a draughting scale. On the contrary if the graduation had been a very little coarser, or a very little finer, the scale would have been an inconvenient one; because then the successive marks would not have matched those of ordinary measures which could not therefore have been so used to make measurements upon the plan; but such measuring would have required a scale especially graduated for the purpose.

The scales appropriate to our old measure are those in which some real quantity of whatever denomination, is represented by 1 inch, by 1½ inches, by ½ inch, ¼ inch, or other of the standard multiples or subdivisions of the inch. The convenience of the subjoined example lies in the fact, that it has $\frac{1}{16}$ of an inch to the ton, every 32nd of an inch representing two cwt. (if the tons are avoirdupois), which lengths are well known divisions of the rules and tapes that have been commonly used for small measurements.

The scales appropriate to the metric system are those in which some real quantity of whatever denomination, is represented by 1 centimeter, by 1.5 cm. by .1, 2, or 3 millimeters, or other standard multiples or subdivisions of the centimeter. The convenience of the subjoined example lies in the fact, that it has 8 millimeters to the ton, every 4 mm. representing 500 kilos. (if the tons are metric), which lengths are well known divisions of the ordinary metric rules and tapes.

For the sake of bringing out clearly the fact that the convenience or inconvenience of a scale is independent of the magnitude of the real thing for which it stands, the example was chosen in which it stands for tons, as in diagrams, for the graphical determination of stresses. These are not lengths. The more common use of scales upon plans is to stand for units of length; generally with our old measures, for miles, chains, rods or feet. For example, the scale already drawn may be taken to stand for furlongs. It thus becomes our old scale of 2½ inches to the mile. Its convenience, as before, lies in the fact that corresponding marks are to be found on our common measures, so that one 32nd of an inch on such a measure can be applied to the plan, just as one chain, which it represents in miniature, is applied to the real things represented by the plan. This convenience is independent of the denomination of measure which is represented. The same scale may represent feet becoming the scale of $\frac{3}{16}$ in. to the foot, useful for plans of buildings.

When it is length that is represented, a magnitude of the same nature as the scale itself, the scale may be designated by its ratio to the reality. Thus 5:192 fixes the relation of the scale last drawn to the real feet which it represents, and the relation of any space on a plan that should use it to the corresponding real dimension. If the vain attempt is made to reduce either term of the above ratio to unity, we may denote the scale in fractional form, as .026$\frac{1}{4}$ or $\frac{1}{38}$.4.

With the metric system the units of length which scales most commonly stand for, are the meter and the kilometer. For this use the same scales are convenient, that are convenient for representing tons or anything else. Thus the subjoined scale is a reasonable one; because ordinary metric measures have marks at every 8 millimeters corresponding to the divisions of this scale which represent meters, and marks at every 4 mm., which correspond to the half meters of this scale. Of course, one centimeter to the meter would be much more convenient; but when something a little smaller than that is required, 8 mm. is clearly the thing to take.

Since with the metric system, the small divisions available for scale are all decimal parts of the meter, while all the larger units of length are decimal multiples of the meter, it follows mathematically that if it is the meter or larger unit of length which is represented, any reasonable scale must admit of being designated by a decimal fraction. A scale which cannot be designated decimally, is not adapted to the metric linear measures. On the other hand with our old measures, it is a rare accident if a reasonable scale can be denoted by a decimal fraction. The truth of these principles is not, affected by the fact that people who ought to know better are perpetually violating them. The variety of incongruous scales used, furnishes abundant and annoying illustrations of the unreasonable practice to be avoided, and justifies us in taking the room to explain an elementary point.

PERSONAL.

W. J. SHERMAN, late Chief Engineer Louisville, Evansville & St. Louis, R.R., has resigned to accept the position of Engineer of Maintenance of Way on the Gulf, Colorado, and Santa Fé R. R. with headquarters at Galveston, Tex.

CHESTER B. DAVIS, of Chicago, Ill., who is gaining an enviable reputation as a hydraulic engineer, was in this City on Thursday. Mr. Davis constructed the Madison, Wis. Waterworks; he was connected for a time with the Omaha Water-works, and is now retained as engineer for the Dallas, Tex. Increased Water Supply, and for the Sewerage of Elgin, Ill.

MAYWOOD, Ill., a suburb of Chicago, wants drainage. There ought not to be any difficuty as the Des Plaines river is its eastern boundary.

TRADE PUBLICATIONS.

F. O. Norton, the well-known manufacturer of Rosendale cement, has issued a unique circular, illustrated by a very good and bonafide etching of his extensive works at Binnewater, N. Y. With it are given official testimonials from the East River Bridge, Davis Island Dam, and from Gen. Stone, Chief Eng. for building the Pedestal to the "Statue of Liberty" on Bedloe's Island. These three letters cover the experience of the consumers of about 152,000 barrels of F. O. Norton Rosendale Cement, and should be very satisfactory to the maker. A new feature in this circular is a graphic representation of breaking strains in from one to six months time, and a comparative table of cost per barrel of mortar, and with Rosendale and English and American Portland Cement.

CORRESPONDENCE.

THE QUAKER BRIDGE DAM.

Special Correspondence Engineering News.

NEW YORK, April 16, 1884.

EDITOR ENGINEERING NEWS.—You were present at the meeting of the Aqueduct Commission on Saturday the 12th inst., and must have been impressed by the complacency with which a specimen of "Young America," under the auspices of the Hon. O. B. Potter, showed to their own satisfaction at least, that the great dam at Quaker Bridge, aside from any question of the feasability of its construction, would prove of no service to the city whatever; and hence that the expenditure of the millions which it would cost, would be so much money expended without an equivalent.

The paper to which I refer showed some smartness of compilation, but the objection, as it appears to me, to its acceptance by the commission, lies in the circumstance that the tables which form the basis of the argument, are not founded upon the facts in the case.

Waiving the minor errors, and the misapprehension of the proper function of city distributing reservoirs, which will doubtless be exposed by the engineer of the commission, and confining myself to the broad outlines of the case, I would call attention to the formation of these tables, wherein the compiler takes the first 17 years from date, during which time he estimates the yield of the Croton basin at its minimum at all times! thus furnishing but 15 inches as the yearly flow from the shed, as in the year 1880: whereas the facts are, that for the 17 years from and including 1865, there has been but *one year* (1880) wherein the flow of the Croton river, as observed daily at the dam, was not at least a third greater, or 20 inches and upwards; the yearly average for the series of 18 years observation being 24.6" and but one year below 20 inches. Now I am well aware that it is not considered safe to estimate from general averages when projecting water works for city supply, unless certain conditions, obtain, and those are, *where extensive practicable storage facilities exist*, and where the meteorological conditions are such, that the years of low rainfall and flow are not grouped together, but spread throughout the years of observation (the latter comprising from 18 to 20 years) at long intervals, as is the case here, and in all the river valleys in this section of country. These conditions existing materially change the estimated capacity of the basin as a source of city water supply.

The difference between his estimates of 15" and the yearly average observed for 17 years, (9".6) is no less than 60,000,000,000 of gallons yearly. What did he propose to do with all this water, which in addition to furnishing 250,000,000 daily, will continue to flow for the next 17 years, as it has done for the last?

It is computed, from all the observations on the Croton basin, that a storage of 146,000,000 of gallons per square mile of water-shed, will give a daily yield throughout the year, equaling the average flow from the basin during the years observed, or with a shed of 360 square miles, with a storage capacity of $360 \times 146 = 52,560,000,000$ gallons, a daily supply of not less than 350,000,000 gallons may be counted on. From which we are fully justified in the assumption that by means of the great Quaker Dam Reservoir, with such additional Reservoirs as may, from time to time, be built within the basin, so far from the limit being confined to a daily supply of 250,000,000, the surplus of the average year carried over, will, with the current flow of a dry year, even if it occurs within shorter intervals than we have reason to suppose, will yield not less than 350,000,000 gallons daily, an amount which, with proper management, will supply the city of New York for all time. But the stored water must not be held in shallow tanks or pans, but in as large bodies as practicable, and the Quaker Dam Reservoir is of the first necessity for the health, comfort and material prosperity of this city, and after its completion, the question of its cost will never come up as a matter to be regretted by the tax-payers.

CONSTRUCTION OF RACE COURSES.

Special Correspondence Engineering News.

DUNMORE, PA., April, 9, 1884.

EDITOR ENGINEERING NEWS:

In answer to R. Swart, I would say, for some time I trusted for literature on the subject of race courses but never found any, except a description of a first class track in "*The Spirit of the Times*," several years ago. Those directions were followed and the resulting track pronounced fine and fast. Much used every year. It had two parallel sides with semi-circular ends. Three feet from the pole or fence line was just one half mile. Width of track 50 ft. on starting side, 30 on the other. Slope of track on curves 1 ft. in 15 ft.

A. D. B.

Special Correspondence Engineering News.

NORWICH, CONN., Apr. 11, 1884.

EDITOR ENGINEERING NEWS:

The fact that I recently had occasion to need just the information regarding race tracks which Mr. Swart asks for, and would like to see the matter discussed, is my principal excuse for a meagre answer to his questions.

1st. I know of none.

2d. I think it is, though the generally accepted form is two parallel tangents connected by two half circles, each being one quarter the length of track. The trouble with the latter is that the change from the straight lines to full curvature is abrupt, complicating the matter of lateral grade on the curves.

3d. The half circle was used in track laid out by me and I have no formula for parabolic curve.

4th. The inside fence or "poles" should according to rules of trotting Associations be three feet from the line on which the length of track is measured. A fair width is 50 feet in general and 60 feet on home stretch.

5th. About one in 12 (less rather than more) is considered the proper inclination by drivers here.

6th. I believe good clay well rolled and drained will make the best track. A mixture of gravel might make it a little "faster." Loam would be better for a training track, not being so hard on the horses' feet.

I think that the form of curve adopted should be such that the additional elevation of outside should begin at nothing at the beginning of the curve, and gradually increase as the curvature increases until the middle of curve is reached. Hoping that some one who has the time at their command will give a good formula both for curve and elevation, I am respectfully,

C. E. CHANDLER.

Special Correspondence Engineering News.

BROOKLYN, April 14, 1884.

EDITOR ENGINEERING NEWS: Mr. Swart will find directions for laying out driving tracks in the *Spirit of the Times* for June 26, 1880, which connects two parallel tangents by semi-circles, making the length of curve= length of tangent. It also adds: "On turns, the track should be thrown up one inch to the foot; and on straight sides raise the outside one foot to secure proper drainage." He must use his discretion in following these directions as they vary with the length and width of track.

The judges' stand should be placed one-fourth the length of one of the straight sides from the first turn.

Clay will *not* make a good track. It will be heavy in wet weather and bake too hard for horses' feet in warm, dry weather, Yours respectfully,

H. B. S.

SOME LIGHT WANTED.

MINNEAPOLIS, MINN., Apr. 10, 1884.

EDITOR ENGINEERING NEWS.—Can any of your subscribers inform us what the material is, which if put in a bottle and corked up for a few hours will emit a brilliant light of any color. Our object is this. We have to measure the velocity of water, at the tail race of a mill, which is in a tunnel and the water running and foaming along at 10 miles an hour. We have tried phosphorus on a board, but it dont work, and we want something which we can clearly see from a given point in the darkness. You will be conferring a great favor if you can answer us immediately.

Yours very respectfully,

STRAW & LYTE.

Annual Report of City Engineer of Fall River, Mass.

Philip D. Borden, Jr., City Engineer of Fall River, Mass., reports the working of his department, for 1883, as follows:—Total street-paving done in year, 6,022 sq. yds, costing on an average $2.22 per sq. yd.; Sewers built, in year, 5,268 lin. ft., cost, $42,657.29, total sewers in use, 128,651 lin. ft., total cost $619,415.54. Considerable change has been made in the nomenclature of the streets of Fall River, during the year past; and they apparently needed this overhauling, judging from the discarded names of Fish Road, Charity Lane, Six Rod Way, &c,; names ancient and smacking of Pilgrim days, but hardly adapted to modern requirements.

The American Water-works Association.

Reported by Our Own Correspondent.

The opening session of the Fourth Annual Convention of the American Water-works Association, was held in Melodeon Hall, Cincinnati, O., on Tuesday, April 15, the President, Mr. J. G. Briggs, of Terre Haute presiding; about fifty active members were present, representing the water supply interests of the country from Massachusetts to Louisiana.

In the absence of the Hon. Thos. J. Stephens, Mayor of Cincinnati, who regretted that the late demands upon his energies had physically unfitted him for the pleasant duty, Mr. John D. Banks, made an address of welcome, and extended the courtesies of the City to the members present. This was replied to in an appropriate speech by the President, Mr. Briggs, who reviewed the history and purpose of the Association, and pointed out some of the good work it was doing, and had already done, in bringing together men identified with the water supply interests of the United States.

The usual routine business was then transacted, including the reports of the Executive Committee and the Secretary and Treasurer. A number of communications were read, some from members who were prevented from attending, others from parties tendering courtesies to the Association.

The Association now numbers 84 members and 32 Associate Members, or 116 in all. Among the suggestions made and resolutions offered, one of the most important was that of raising the initiation fee and annual dues; the present trifling sum not being commensurate with the position and purpose of the Association, and the lack of sufficient funds for that purpose preventing the publication and distribution of valuable papers read before it.

The afternoon session was mainly occupied in the reading of a paper upon the "Condition of the Ohio River Water," by Mr. George Hornung, Supt. and Engineer of the Water-works of Newport, Ky.; and by the paper of Mr. B. F. Jones, of Kansas City, Mo., upon "Hydraulic Elevators and Motors;" this latter topic led to a lengthy and interesting discussion by the members. The meeting then adjourned for the day.

The programme of the Convention we have already published; the following is a list of members attending the opening session of Tuesday:

J. G. Briggs, *President*, Terre Haute, Ind.; J. H. Decker, *Secretary*, Hannibal, Mo.; W. C. Stripe, Koekuk, Ia., H. H. Harrison. Stillwater, Minn., B. F. Jones, Kansas City., Mo., Edwin Darling, Pawtucket, R. I., R. Holme, Jr., Denver, Col., D. G. Holcombe; Geo. A. Ellis, Springfield, Mass., C. S. Brown; Carl Schön, Toledo, O., A. G. Moore and Thos. J. Bell, Cincinnati, O., F. W. Holly, Lockport, N. Y., Wm. Ryle, Patterson, N. J., J. M. Carson; Alex. Richmond, Dayton, O., W. S. Hamilton. Youngstown, O., H. F. Dunham, Cleveland, O., L. H. Gardner, New Orleans, La., Geo. R. Harlow, Pittsburg, Pa., B. R. Horton, Newport, Ky., Z. M. Ashford, Jas. H. Andrews, Pawtucket, R. I., H. G. Ludden; L. A. Taylor, Worcester, Mass., A. H. Martin. Fall River, R. I., J. P. Donahue; Thos. H. Hooper, Geo. H. Chandler, Kalamazoo, Mich., C. C. Rensford; J. M. Diven, Elmira, N. Y., G. E. Beach; D. McN. Stauffer, ENGINEERING NEWS, New York, and Jas. Waters.

Asso. Members present or represented:

Dennis Long & Co., Louisville, Ky., Ripley & Kimball, St. Louis, Mo., Cin. & Newport Iron & Pipe Co., Newport, Ky., Union Water Meter Co., Worcester, Mass., Bingham & Morgan, Buffalo, N. Y., National Meter Co., New York, W. S. Payne, Titusville, Pa., Equitable Water Meter Co., Boston, Mass., Wm. D. Hooker., Saml. M. Strang, Farquhar Filter Co., N. Y., H. R. Worthington & Co., New York.

Engineers' Club of Philadelphia.

[*Record of Regular Meeting, April 5th*, 1884.]

Past President Henry G. Morris in the chair; 36 members and 2 visitors present.

Mr. Henry G. Morris exhibited, on behalf of Mr. Israel W. Morris, two ancient and curious works upon mining;—"The Golden Treasury, or the Complete Minor, being Royal Institutions or Proposals for Articles to Establish and Confirm Laws, Liberties and Customs of Silver and Gold Mines," by Thom. Houghton, London, 1699, and "A Collection of Scarce and Valuable Treatises upon Metals, Mines and Minerals," by James Hodges, London, 1740. The latter contains, *inter alia*, "How to know the Condition of the Earth by Taste;" "Of Juices, and first of Alum." "The Opinion that Quicksilver and Sulphur are the Matter whereof Metals are made, is Defined." "How to know the ill Qualities that infect the Oar, and how to purge them away." "Wherein is showed how true and perfect Gold may be made by Art, with Loss to the Workman."

Mr. Henry G Morris gave a brief description of an Atmospheric Elevator, consisting of a closed cage or car working in an air tight well, the air pressure, supplied by a "Root" or other pressure blower, being admitted to the top or bottom of the cage, in descending or ascending. The doors at the different stories opening inwards, the pressure of air keeps them closed until the interior of the car is brought opposite when the pressure being relieved, the door can be opened into the car. The car being counterbalanced, only a comparatively slight pressure of air, equal to a water column of 6 to 8 inches only, is required to move an average load on a car six feet square. The escape of air beneath the car being at all times readily controlled by the atttendant, it is impossible for the car to descend at a dangerous speed, and other obvious features render this form of elevator comparatively safe.

Mr. Henry G. Morris also exhibited a sample of Seamless Copper Tube which had been compressed endwise under a steam hammer, and showed peculiar foldings of the metal into overlapping equilateral triangles forming an interior hexagonal section. The absence of fractures showed great purity of material.

Mr. John T Boyd described a new design for Parlor Cars for the Pennsylvania R. R.

The Secretary presented, for Mr. Edward Parrish, an illustrated description of Powers' Disinfecting Tank and Automatic Syphon.

The Secretary presented, for the Reference Book, a table which he had prepared of Vulgar Fractions of 1 in. Reduced to *Exact* Decimals of 1 in.

Mr. Wm. L. Simpson exhibited a remarkably perfect casting of a toad, the pattern used being the toad himself.

[RECORD OF MEETING, MARCH, 15th, 1884.]

President William Ludlow in the chair; about 35 members and 5 visitors present.

The following gentlemen were elected Active Members of the Club; Messrs. Kenneth Allen, J. M. Rüdiger, Jr., Frederic C. Wootten, Edw. H. Barnes, Walter D. Heston, Robt. W. Lesley, Wm. Paul Gerhard, Jesse T. Vogdes, Jos. J. McKee, P. A. Taylor, Wm. Wharton, Jr., F. A. Dean, De Courcy May, Jas. Rowbottom, V. E. Briand de Morainville, Richd. W. Jones, Augustus Dietz, Wm. H. Millard, James Christie, H. G. Stewart, W. A. Parry, Theo. J. Lewis, E. R. Wallace, and B. K. Field.

Mr. Robt. P. Field presented a description of a method he had used to obtain formulæ for Switch Calculations.

Mr. C. Henry Ott presented an account of a recent Establishment of True Meridan in Philadelphia.

William Lorenz presented Blues of the Steel Superstructure which he had discussed at a recent meeting.

Messrs. Young & Sons, Phila., submitted sample of Stake Tacks. In the head of each is a concavity to admit point of rod. Thus another, although trifling, source of error may be eliminated, and the engineers' tacks may be more readily distinguished from others.

Foundation of the Cleveland, O., Viaduct.

At the meeting of the Cleveland Society of Civil Engineers, on Tuesday evening the 8th, City Engineer B. F. Morse read a short paper on the settlement in the west end of the big Viaduct.

Mr. Morse opened the subject by the statement that it was very seldom that masonry of such weight is built so perfectly as to prevent any settlement. Among the figures introduced into the paper were the following: The total length of the piles driven into the Erie clay, a blue quicksand under the foundation, is forty-five miles. These are thirty to forty-five feet long and driven two to three feet apart. They are sawed off one foot below the surface and a bed of concrete laid to the top, upon which are timbers filled in between with concrete. The weight on each square foot is five tons. Tests were made yearly from 1875 to 1879, and for that time the settlement was from 2½, on row No. 8, to 5 inches on row No. 17; since then the settlement has been only from ½ to ⅝ inches. Mr. Morse said the most remarkable fact was the uniformity in the settlement. In touching on this subject Mr. Morse advanced the idea that foundations on the table-land upon which the business part of the city is located were more liable to settling than those on the Flats, built, as they were, over springs and quicksand. He suggested that the subject be looked into. President Hollaway thought that displacement more than settlement was the cause of danger on this table-land. The Wilshire building was cited as having a weight of two tons to the foot on its foundation and having shown no signs of settling. The importance of the subject will command the future attention of the society. At the conclusion of the discussion on this subject Mr. S. J. Baker, a member of the City Engineer's Corps, read an entertaining paper on the early surveys of Cleveland.

Board of Public Works, New Haven, Conn.

Albert B. Hill, City Engineer of New Haven, sends us the annual report for 1883. of the Board of Public Works for the city named. In the section upon Bridging, a table is exhibited detailing the cost per square foot per annum of keeping in repair the roadways of wooden bridges within the city limits; the average cost is 6.3 cents per square foot., which capitalized at 5 per cent. is $11.25 per square yard; from which it is argued that the city can afford to pay nearly that price for a permanent roadway. No repairs have been needed on the asphalt bridge-roadways.

There are now $39\frac{395}{1000}$ miles of sewer in New Haven, $1\frac{386}{1000}$ miles having been built in 1883. An intercepting sewer has been planned for the West River. Tables are given showing the size, length and materials of all the sewers in the system.

Paving laid last year 30,403 square yards; total length of paved streets $16\frac{475}{1000}$ miles, of which $12\frac{567}{1000}$ is Telford, which is reported as the most expensive to maintain

Mr. Hill, in his report, after giving the good and bad points in existing paving material, rather favors Asphalt; stating that while Telford is the cheapest at first cost (about $1.25 per square yard) the annnal cost for repairs amounts to $4\frac{5}{10}$ cents per square yard. Asphalt pavement he estimates at $3.00 to $3.50 per square yard, and in Washington, D. C, it costs less than 2 cents per square yard, annually for repairs. Capitalizing the Telford repairs at 5 per cent. would however make that better from a financial point than any costing more than $2.25. per square yard, leaving all other considerations out of the question.

The report concludes with an Obituary upon Chas. Edward Fowler, who died Jan. 28, 1883, and had for nearly fourteen years previously been the City Engineer.

Inadequate Supports in Mines.

WILKESBARRE, Penn., March, 22.—The frequent caving in of mines beneath towns and villages in the anthracite coal regions is beginning to create much apprehension in the minds not only of mine owners and miners, but also of the inhabitants of the regions; and whether or not they can be prevented is coming to be an important subject for discussion, from Carbondale in the upper Lackawanna region to Maunch Chunk in the lower Lehigh.

A well informed man of large experience in coal operations in the Lackawanna Valley said to-day that the collapse is in a great measure due to unscientific and careless mine engineering. The coal deposits lie in veins between layers of rock. Men are at work in the upper vein, others toil in the vein next below, and others in still deeper veins. Heavy pillars of coal are left standing at intervals in the chambers to support the roof above them. In European mining countries engineers map out the working interior of the mines with great care, and miners are compelled to take out the coal according to the plans of the engineer. The location of pillars is designated on these plans. They must stand one beneath the other from the top vein to the bottom one, thus giving a firm and solid support to the roof and floors. The giving way of the roofs of mines, thus endangering life and property on the surface, is not known in European mining regions, although the fall of top coal and rock in the mines between pillars is as common as in American collieries. These coal pillars are left standing and remain perpetual supporters of the mine roof. In this country the layout of mine interiors is not so strictly scientific. The miner in one vein selects the spot for leaving a pillar as suits him; and the miner in the vein below locates his in the same manner, without regard to the places where the upper supports may be. Even the questionable safety thus offered is taken away when a mine is worked out; for then the mine is robbed of its coal columns, which are replaced by props of timber. These rot away in time, and leave the roof of the mine entirely unsupported, to fall in at an unexpected time and cause greater or less destruction.

Every city, town, and village in the anthracite region stands over a net work of coal mine tunnels and chambers. In one of the most populous wards of this city one of these mines caved in recently, demolishing or badly damaging many buildings, and rendering it impossible for the houses to be rebuilt on their former sites. Different portions of Scranton have been visited with similar disasters, and there is scarcely a mining town in the entire anthracite region which has not met with great loss by the sinking in of the roofs of mines. Hundreds of miners have been killed and maimed. Every one of these cavings is traced directly to the result of the careless system of mining mentioned above. Owners of property located over the mines will make an effort at the next meeting of the Legislature to compel mine owners to adopt a more scientific and careful system of operations, and to leave more substantial supports than timber in abandoned mines.—*N. Y. Times.*

Chester B. Davis, C. E., of Chicago, is completing a general sewerage and drainage system for Elgin, Ill., Construction will be at once begun.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 177*)

DCXIX. ST. GABRIEL, QUE.

St. Gabriel, Quebec, in lat. 45° 25′ N. long. 74° W. is a western suburb of Montreal.

Settled in 1874, it was incorporated a village about 1876.

Water-works were built in 1881 by the village after plans of A. Massy, C. E., the supply being taken from the Ste. Cunegonde works, a contract for 15 years supply being made with the proprietors of those works.

There are 8¼ miles of distribution pipe of 10 to 4 in. diameter, with 18 hydrants, 22 gates, 6 meters, and 1,100 taps. Service pipes are of lead. The town pays 30 cents per 1,000 gallons for use of water for fire purposes.

The population in 1883 was 6,200, and the daily consumption about 300,000 gallons. The works cost about $65,000.

DCXX. ST. HENRI, QUE.

St. Henri, Quebec, in lat. 45° 25′ N. long. 74° W. is a western suburb of Montreal. Settled in 1872, it was incorporated a city in 1873. Water-works were built in 1880 by Berger & Béique, as a private enterprise, taking the supply from their works at Ste. Cunegonde.

Distribution is by 9½ miles of cast iron pipe of 10 to 4 in. diameter, with 32 fire hydrants, 34 gates, 9 meters and 1,550 taps.

Service pipes are of lead. It is not stated how much the town pays for hydrants. The population in 1883 was 7,550. The cost of the works has been $112,000.

DCXXI. COTE ST. ANTOINE, QUE.

Cote St. Antoine, Quebec, in lat. 45° 30′ N. long. 74° W. is a suburb of Montreal.

Settled about 1881, it is now an incorporated town. Water-works were built in 1883 by a private company, the plans being furnished and work done by J. B. A. Béique. The supply is taken from the Montreal works and paid for at the rate of 40 cents per 1,000 gallons. The pressure obtained is 40 lbs.

Distribution is by 2¼ miles of cast iron pipe of 10 to 4 in. diameter, with 4 fire hydrants, 12 gates, 6 meters and 12 taps. Service pipes are of lead.

The population in 1883 was 600. The works have cost $15,000. The capital stock of the company is $20,000. A. A. Dickson is Secretary & Treasurer of the company.

DCXXII. AUSTIN, TEX.

Austin, Travis Co., Texas, in lat. 30° 16′ 25″ N., long. 97° 43′ 58″ W., is on high ground on the North bank of the Colorado River at the head of navigation the general elevation being about 650 feet above the sea.

It was selected as the capital of the Republic of Texas in 1839, and of the State in 1850. The surrounding country is fertile, and the city contains all the state buildings, and is the seat of large manufacturing interests.

Water-works were built in 1875 by a private company after plans of W. R. Freeman, C. E., the water being taken from the river and pumped by a Blake steam pump to a reservoir. These were the first water-works built in the State. In 1882 the works were entirely reconstructed after plans of M. C. Orton, C. E., the supply being taken from a well 50 ft. in diameter and 25 ft. deep, sunk in sand and gravel on the river bank, the bottom of the well being lower than the bed of the river. The water is pumped directly into the mains by a quadruplex Holly steam pump of 3,000,000 gallons daily capacity. A duplex Worthington steam pump of 2,000,000 gallons capacity is held as a reserve. The ordinary pressure is 100 lbs., and the fire pressure 160 lbs.

Distribution is by 20 miles of cast iron pipe of 20 to 4 in. diameter, with 135 fire hydrants, 80 gates, 75 meters and 1100 taps. Service pipes are of wrought iron with lead connections. The City pays $100 annually for each of the first 100 hydrants, and $50 annually for each additional hydrant. The daily consumption in 1883 was about 1,000,000 gallons. The population in 1880 was 10,960, it is now estimated as 20,000. The capital stock of the company is $350,000, and its bonded debt $340,000 at 7 per cent.

The works have cost $350,000, and it is intended to extend them at an additional cost of $50,000. The receipts in 1883 were $36,500. M. D. Mather is President, and D. L. Wickes Secretary and Treasurer of the company.

CORRECTIONS.—*Unadilla, N. Y.*, p. 164. Samuel North is the owner, not *Worth*, p. 164. The New Jersey State reform school is at Jamesburg, not *Jamesbury*.

WATER.

LEXINGTON, Mo., will vote on the Water-works question in June. Property owners are in favor of it.

DANFORTH, N. Y., is seeking permission to get a supply of water from Syracuse, N. Y.

JERSEYVILLE, ILL., is proposing to have Water Works, and Springfield, Ill., proposes to have additional supply.

THE Davidson Steam Pump Co. will have their principal office after May 1st, at 77 Liberty street, where they are to be addressed after that date.

THE letting of contracts for the Jackson, Tenn., water works has been postponed, and it is probable new advertisements for proposals will be issued.

THE amount of water pumped by the Duluth, Minn., Water Company to supply their patrons, averages about 200,000 gallons per day.

DENNIS LONG & Co., of Louisville, Ky., have the contract for water pipe for Lake View, Ill. Prices, delivered in Chicago, $33.70 for 4-inch, $33.75 for 6-inch, and for 12-inch, delivered at Ravenswood, $34.35.

GOVERNOR ROBINSON, of Massachusetts, has vetoed the Watertown, Mass., Water Supply Bill on the ground that it did not receive the support of two-thirds of the votes of the people asking for the new supply.

THE Water-works Company of Danville, Ill., have accepted the ordinance releasing them from putting in filters, and instead to construct a reservoir with a capacity of 2,000,000 gallons, to be completed in six months from the date of said ordinance.

THE Davidson Steam Pump Company are now building the pumping engines for the towns of Whitehall, N. Y., North Attleborough, Mass., and Hopkinsville, Ky. All of the type known as the M. T. Davidson, Improved, Compound, Condensing, Pumping engines, with independent air pumps and condensers.

DALLAS, Texas, will build water works after the plans and specifications of Chester B. Davis, Hydraulic Engineer, formerly Chief Engineer of the Madison, Wis., Water Works. To cost $250,000. Recourse will be had to a large series of collecting and filtering chambers at a suitable depth. A stand-pipe system will be adopted and as much as practicable of the old works, which includes twelve miles of small pipeage, will be made use of.

NORWALK, O., April 14.—The following are the officers chosen by the board of waterworks trustees: President, A. Firgel; superintendent and secretary, A. Joslin; chief engineer, H. Wingert; first assistant examiner, L. G. Fell; second assistant examiner, F. Book. The re-election of Mr. A. Joslin, Democrat, as superintendent and secretary by a Republican board is a deserved compliment to a capable and faithful officer.

THE Water Committee of Pittsburg, has awarded the following contracts: 50-inch pipe to R. D. Wood & Co., of Philadelphia, for $30.70 per ton, and special castings 3 cents a pound; 36-inch pipe to the Warren Foundry Company, of Phillipsburg, N. J., at $29.35 per ton, and special castings at $55 per ton; special and miscellaneous castings for Brilliant and lower water-works at $2.80 and $2.95, respectively, per 100 pounds, to William Yeakle & Co., of that city; small water-pipes at $40, to Dennis Long & Co., of Louisville, Ky.

ON last "Club night" the University Club rooms at 1316 Walnut Street, Philadelphia, were well filled with members and their guests. Colonel William Ludlow, chief engineer of the Water Department, was the speaker of the evening. His theme was, "The Water Supply of Philadelphia," and in his address he included the leading statements which were made in the address before the Board of Trade last month. After alluding to the excessive waste of water by householders and manufacturers, he criticised very severely the bad plumbing of the so-called plumbers of the city, and claimed that the death rate of Philadelphia, though small, was larger than it ought to be, simply because of bad plumbing and bad sewerage. He continued:

"Your sewerage is the worst in the United States. The sewerage on Walnut Street is nothing but an elongated cesspool. The old city is built on a sewage saturated soil. Your highways are the worst not only in the United States, but in the world. It gives me relief to light out on these things, especially when I think of the condition of the Water Department.

He then commented on the impurities of the Schuylkill water and the plans for future supply. The surveys which have been made of the water basins of surrounding territory have resulted in the finding of several that are available. The Delaware basin at the Gap would afford excellent water, and gravity would be a most useful agent in bringing it to the city. Another project would be to use the waters of the Lehigh Valley, from the neighborhood of Mauch Chunk, conveying the water through an iron pipe, to a convenient and accessible point on the Perkiomen river and thence bringing it to the city. Colonel Ludlow spoke strongly, upon the need of devoting the revenues of the Water Department to the department's own uses and not turning them over to the other branches of city works. "Our annual surplus above expenditures will average $550,000. Last year it was $580,000. This year it will probably be $900,000. We have plenty of ways to use this balance advantageously and the power ought to be given to us."

THE Ramapo Improvement Co., which proposes to supply New York City with water from New Jersey, consists of Frederick A. Conkling, President, and Richard Kelly, R. Nuthall-Laurie, Charles Quincy, William J. McAlpine, William McClure, and William J. Norton, Trustees.

Col. Conkling said that the company expected to receive $983,650 annually from the city for delivering 50,000,000 gallons daily.

William J. McAlpine, the engineer of the company, was satisfied that the work could be completed in two working seasons, and that there was absolutely no risk to the city. Controller Grant argued that within three years an ample supply of water would be had from the Croton district by the new scheme of the Aqueduct Commissioners, at an outside cost of $25,000,000. The annual interest charge on that amount would be $750,000. The amount asked for by the Ramapo Company represents a capital of $33,000,000, and in addition the city would have to pay the cost of bringing the water 18 miles.

NEWS OF THE WEEK.

Railroads, and Canals.

RUDOLPH FINK has been appointed Receiver of the Memphis and Little Rock Railroad.

THE earnings of the main line of the Mexican Central 440 miles out from the City of Mexico the fourth week of March were $61,948.

RAILWAY construction in the United States continues light and last week reached a total of only 51 miles of new railroad, making 437 miles reported to date for 1884.

AMONG new railroad corporations is the Des Moines and Dakota; capital, $20,000,000, proposed route, northwest from Des Moines through South Dakota to a point on the Northern Pacific.

A NEW narrow gauge R. R. is being constructed along the Deerfield River from the East portal of the Hoosac Tunnel, Mass., to Readsboro, Vt. Geo. H. Hutchinson is the engineer in charge of construction, with address at Hoosac Tunnel.

RAILROAD men state, that the rails to be obtained now are not as good as they were when first introduced. Superintendent Toucey, of the New York Central, thinks the average life of a steel rail may be placed at fifteen years; others say it is not more than seven to ten years.

SAVANNAH, Ga., April 12.—A movement is on foot to build a new air line road from Atlanta to Baltimore, to compete with the Richmond and Danville and the East Tennessee, Virginia and Georgia systems. The Central Railroad of Georgia—a recognized power in the South—is believed to be behind the new project.

THE results of last year's inspection of the tracks and roadbeds of the principal railroads of the country by Prof. P. H. Dudley with his dynograph car have just been tabbulated, and show that the Boston and Albany's are the best in the country. The second on the list is the Pennsylvania, which has for years had a great reputation for its fine roadbed.

THE officers of the Boston and Albany Road will make a trip of inspection over the line this week.

GEO. C. VENABLE, of Memphis, Tenn., and several parties in Cass Co. Texas, are building a 3 feet narrow guage lumber railroad from a point on the Texas & Pacific R. R. one mile east of Wayne station in the above County, to

run westwardly six miles into the "piney woods." Owen Meriweather, C. E., 245 Second St. Memphis, Tenn., is the constructing engineer.

Hamburg, Pa. April 17.—The several engineer corps of the Pennsylvania Schuylkill Valley Railroad have located the new road through the Western section of this borough. The road will cross the Schuylkill River at this point, necessitating the construction of probably the longest bridge along the entire railroad.

The following are the officers for 1884 of the McPherson, Kingman and Fort Worth, R. R. Kan; G. M. Hartzell, President, and General Manager, L. C. Almond, Vice President; Rudolph Hatfield, Treasurer; Oliver Mulvey, Chief Engineer and O. H. Bentley, Secretary and Attorney. Headquarters, Wichita, Kan.

Chicago, April 10.—At a meeting of the Cihcago, Wisconsin and Northern Railroad Company, in Waukesha, Wis., to-day, A. E. Perkins, was elected President; H. M. Enos, Vice-President; T. W. Haight, Secretary; Henry P. Glover, Treasurer, and E. W. Chapin, Solicitor. A committee was appointed to proceed to Chicago and confer with a construction company. The capital stock was increased to $2,000,000. Henry S. Hawley, who represents the Eastern capitalists interested, was present, and in conversation denied that the road was to be a southern extension of the Wisconsin Central. It will be built principally by Eastern capitalists. Surveyors left Chicago to-day on the second line. It is expected 100 miles of road will be built before next Winter. From some point in Washington County Wis., the road will be continued to Florence, under the name of the Illinois, Wisconsin and Michigan Railroad.

Contracting Miscellany.

Allen & Van Tassell of Ionia, Mich., has the contract for the New County Court House at Adrian, Mich. Price $47,600.

N. Le Brun is the architect of a new $100,000 Catholic Church, to be built immediately on W. 51st Street, near 10th Ave., New York City.

John H. Austin of Bridgeport has been awarded the contract of pipe laying for about ten miles of pipe for the Southington waterworks, and commenced work April 5th. Works on the storage and distributing reservoir dams is expected to be completed July 1st.

Toledo, O., April 15.—Owing to the action of the Supreme Court in deciding that the adoption of the plans for the new Insane Asylum by the commission was illegal, the opening of the bids and letting of contract, which was to have been done to-day, was necessarily postponed. It is understood that the trustees of the Asylum will adopt the plans and re-advertise for bids, which will cause about a month's delay.

Bridges.

The Phœnix Bridge Company succeeds the old firm of Clarke, Reeves, & Co., dissolved. The only change in the personal is that Mr. T. C. Clarke has gone out of the partnership to become a member of another bridge building company.

The Kansas City Bridge and Iron Company was awarded the contract for building the 150-foot Howe truss bridge over the Blue river one-fourth or a mile north of Independence avenue, Kansas City, Mo. The contract was awarded by Mr. Daniel Boutecou, Chief Engineer of the Belt railway, and the bridge is to be completed within six weeks.

Messrs. Le Duke & Alexander, have taken the contract to finish the Kentucky and Indiana Bridge at the foot of the Ohio Falls. As far as known now the bridge will be used by the Louisville, New Albany and Chicago, St. Louis Air Line, and the Huntington system of roads and their connections, and it is quite likely that Huntington is engineering the finances of the enterprise.

The Lidgerwood Manufacturing Company, of 97 Liberty Street, New Rork, among recent orders report the sale of two of their Improved Patent Friction Drum Hoisting Engines to the Lehigh Valley R. R., for use on their docks at Perth Amboy. One Pile Driving Engine to the Phila. & Reading R. R., one to the Flint & Pere Marquette R. R., and three to the Alabama Great Southern R. R. This company make a specialty of Hoisting Engines for railroad purposes.

M. B. Hewson, C. E. of Chicago, Ill., has recommended a comprehensive system of sewers for Cicero, Ill., to cost about $1,000,000. He has just reported to the Trustees.

Cape Cod Canal.—The report of the minority of the Committee on Harbors and Public Lands regarding the Cape Cod Ship Canal Company contains some very important facts, among which are the following:

1. No corporator named in the charter and no director of officer of the Canal Company has ever subscribed to any of its stock or pay anything whatever to the business of the company.

2. That the company has contracted with F. A. Lockwood to build the canal at $1,000,000 per mile, that Lockwood shall receive all the stock which is to be issued to him as the work advances, and that when he shall have received $5,000,000 of the stock, the company shall issue its bonds to that amount to the contractor to complete the rest of the work, so that the canal will represent $10,000,000 of money regardless of the cost of construction.

3. That the construction of the canal depends upon the success of the "dredger," in which the contractor is interested.

4. That it is contrary to public policy for one man to constitute a company which has authority to take more land than was ever before taken by a single corporation in Massachusetts.

5. That the company estimating the cost of the canal has made no provisions for the construction of the bridge, ferries, etc., which will be necessary, and no sureety has been furnished by the contractor for their construction.

6. That the conditions of last year's act have not been complied with and that nobody is now interested in the scheme except Mr. Lockwood, the contractor.

7. That the construction of the canal would interfere with the railroad, which is the only communication with the outside world.

8. That the contractor has not given the land owners any security for damages, but can enter upon the lands of private persons without permission.

Canada's Enormous Debt.

Ottawa, Ont., April 8.—There is great excitement here to-day, over a resolution introduced in Parliament last night, granting over $9,000,000 subsidies to aid the railways throughout the Dominion. The reckless extravagance of the government is condemned by some of its strongest supporters. They are evidently running the country hopelessly in debt. The work of this season adds at least $45,000,000 to the national debt, which, added to the existing debt of $202,000,000, gives a total of $247,000,000 the people of Canada will owe at the end of the year. It will be matter of surprise to everyone if the Finance Minister who leaves shortly for England to raise a loan of $40,000,000, is not obliged to return home with empty pockets.

A mode of hanging paper on damp walls has been patented in Germany. Lining paper, coated on one side with a solution of shellac in spirit, of somewhat greater consistency than ordinary French polish, is hung with the side thus treated toward the damp wall. The paper-hanging is then performed in the usual manner with paste. Any other description of resin, that is of equal solution in spirit, may be used in place of the shellac. According to the representations made of this process, a layer of paper thus saturated with resin is found equally effectual in preventing the penetration of damp.

IRON, METAL AND COAL MARKETS.

Philadelphia, April 17, 1884.

For the past week, but little change can be reported in the iron market, though perhaps a little activity is to be found in some special kinds. The production is still too great for the consumption, and prices are weak. Offerings are largely in excess of inquiries, and buyers cannot be induced to purchase for more than their immediate requirements. Standard No. 1 Foundry is held at $20 and No. 2 at $19. $18 is still asked for Gray Forge, but there is very little moving even at that figure. No sales of any moment have taken place in Bessemer, as $20 is the price offered, and makers do not seem willing to sell at that figure. Spiegeleisen is offered at $29, but with very little movement. No heavy sales are reported in steel rails; $34 is asked and a few small sales have taken place at that price. Perhaps some slight concessions might be obtained on large lots, but buyers do not seem eager with their offers, and no large transactions are in sight. There are but few sales in Structural Iron. Some little activity is reported in Sheets, but prices rule the same as heretofore. $2.50@$2.60 is still quoted for Nails, and some buyers are said to be looking around, but it is not thought that any large orders will be placed unless lower prices can be obtained. We quote old T. Rails $21.75@$22. Bridge and D. H. $23.50@$24.50. There have been some trifling sales in Merchant Bar. Quotations $1.90@2c. Very little activity is looked for at present, and it will probably be some time before any marked improvement can be hoped for.

Pittsburgh, April 17, 1884.

The Iron market remains quiet in nearly every department. Very little is doing in Mill and Foundry Irons. Mill is quoted at $17@$18 for No. 1. $19@$20 is asked for No. 1 Foundry and $18@$19 for No. 2. Bessemer Iron remains inactive; quotations are $20@$21. $35@$36 is asked for Steel Rails at mill, but no large transactions are taking place. There is some little activity in Railway materials. Old T. Rails are held at $23@$24. Some little is being done in Merchant Bar to meet the absolute requirements. Prices remain unchanged, being about $1.70@2c. $32@$33 cash is asked for best grades of Muck Bar, though inferior qualities are selling in moderate quantities at lower figures. Nails are quoted at $2.45@2.55. The nail makers have formed a pool for the better protection of their interests. The country from Pittsburg and vicinity to as far wes as St. Louis, is divided into four sections. Each sectio will have two representatives, and they will, with a President, be formed into a Board of Control to regulate the price and sale of nails. No change has as yet been made in the card rate.

Chicago, April 17, 1884.

There seems to be some slight improvement in the Iron trade during the past week. Though the increase in the volume of business is small yet it has had an encouraging effect, and the manufacturers seem to feel a little more hopeful. Yet the improvement is hardly large enough to be very satisfactory, and though the most eager and enthusiastic prophesy a continued movement towards a better condition, the change is hardly marked enough to warrant any decided assertion that there will be any great revival of activity. Prices remain substantially the same. In Pig Iron, there is a moderate movement for immediate requirements. Domestic Irons, particularly those of Southern manufacture, are still preferred to the Foreign Irons. These latter are quite inactive, and the dullness seems to increase. It is not thought that prices will go any lower. There has been a good deal of inquiry, but no large transactions have as yet taken place. There is a slight improvement in the demand for manufactured Iron. Though the city trade is perhaps as quiet as usual, there are inquiries and mill orders arriving from the country. Bar Iron is selling in a small way at $1.90 for common and $2.00 for refined, but these prices are shaded in round orders. In Structural Iron very little can be said. The market is very quiet, and concessions are not hard to obtain. There is some demand for Tank and Angle. Quotations are as follows: Tank $2.50, Angle $2.60. Beams and Channels $3.60, Shell $3.00@$3.25. Scrap Iron is rather weak. No. 1 Wrought is held at $17, but buyers are holding back. There has been more activity in the Steel market, but whether it is more than temporary remains to be seen. Hope, however, is strong and the tone of the market is improved. In Steel Rails prices are nominally unchanged and some fair contracts have been placed at prices not given, but it is thought that concessions have been made by the manufacturers. Nails are quoted at $2.50 for car-load lots, but for smaller lots $2.55 is asked. These prices are not very steadily maintained, however, and large buyers can obtain favorable concessions. The demand for Ingot Copper has improved considerably. Prices are steady at the following quotations: Lake, 14¾c.; Baltimore, 14¼c., and Arizona 14c., with usual concessions on large orders.

COAL.

Philadelphia, April 17, 1884.

The situation in the coal trade has not been modified by the stoppage this week, and buyers are still of the opinion that the coal combination has the worst of it. There is a belief prevalant that a downward tendency in prices will develop itself sooner or later, and the reasons for this belief are that the suspensions, amounting to 55 days in all, since the first of the year, have not led to any firmer prices nor stimulated demand, and manufacturers' orders are still held back. Besides, the production of coal is in excess of the requirements. Consumers think this will lead to a further depression. The present prices are being shaded. Considerable unrest prevails among the workmen. Inferior coals are being offered at very low prices. Great activity prevails in the Bituminous region. Large contracts have been placed within 48 hours. Still larger ones are pending, which, it is thought, will be placed on Saturday. This activity will not stimulate prices, however, as the operators are too anxious to make themselves safe with contracts at present prices.